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The total cost of the project was $190,000. The district

(Continued on Page 2)

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E = mc²

The Department of Natural Resources and Conservation, the Montana Power Company, the Department of Commerce—Board of Investments and he Office of Public Instruction have formed a public/private partnership and developed a program to provide up-front cash to identify and install energy and money saving improvements in Montana school buildings. The improvements can range from lighting projects to replacing a boiler.

E = mc² program is the solution to rising energy costs in Montana schools. E = mc² is an equation that stands for EFFICIENCY = managing costs carefully. The E = mc² program has five main elements.

ENERGY USE EVALUATION

REVIEW OF EUE

TECHNICAL ASSISTANCE STUDY

REVIEW OF TA

FINANCING PACKAGE

The coordinated efforts of DNRC, utilities and the Board of Investments will minimize the administrative burdens placed on the school.

If you would like to learn more about the E=mc² program, or if you have questions, call Connie Onstad at 444-6777.

DNRC Offers Video Tapes For Builders Operators

The Energy Division of the Department of Natural Resources and Conservation (DNRC) has established a lending library of videotapes that are beneficial to owners and operators of commercial and institutional buildings. We have recently added 12 new tapes to our collection, including topics such as energy efficient lighting, electric motors and applications of all-air and all-water HVAC systems. The new tapes are indicated on the enclosed brochure. Other tapes available offer information on air conditioning systems, boilers, steam systems, and HVAC systems.

The videotapes are offered at no cost to Montana residents. One or two tapes may be borrowed for up to two weeks with the order form on the back of the enclosed brochure. To obtain further information contact Kerry Campbell at 444-6760.

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For Commercial and Institutional Building Operators

September 1989

Inside...

The Department of Natural Resources and Conservation welcomes you to Energy Source. This periodic bulletin focuses on energy management in commercial buildings. In this edition, we discuss:

- Great Falls High School boiler
- Group relamping
- Filters on HVAC equipment
- Maintenance of controls
- NATAS
- Results of the reader survey
- Upcoming events
- Videotape library

Funding for this issue is provided by the Department of Energy. Address your correspondence to:

Peggy Nelson

Department
of Natural
Resources and
Conservation

1520 East
Sixth Avenue

Helena, MT
59620-2301

444-6697

Four Year Payback Is Projected

Great Falls School Installs High Efficiency Boiler

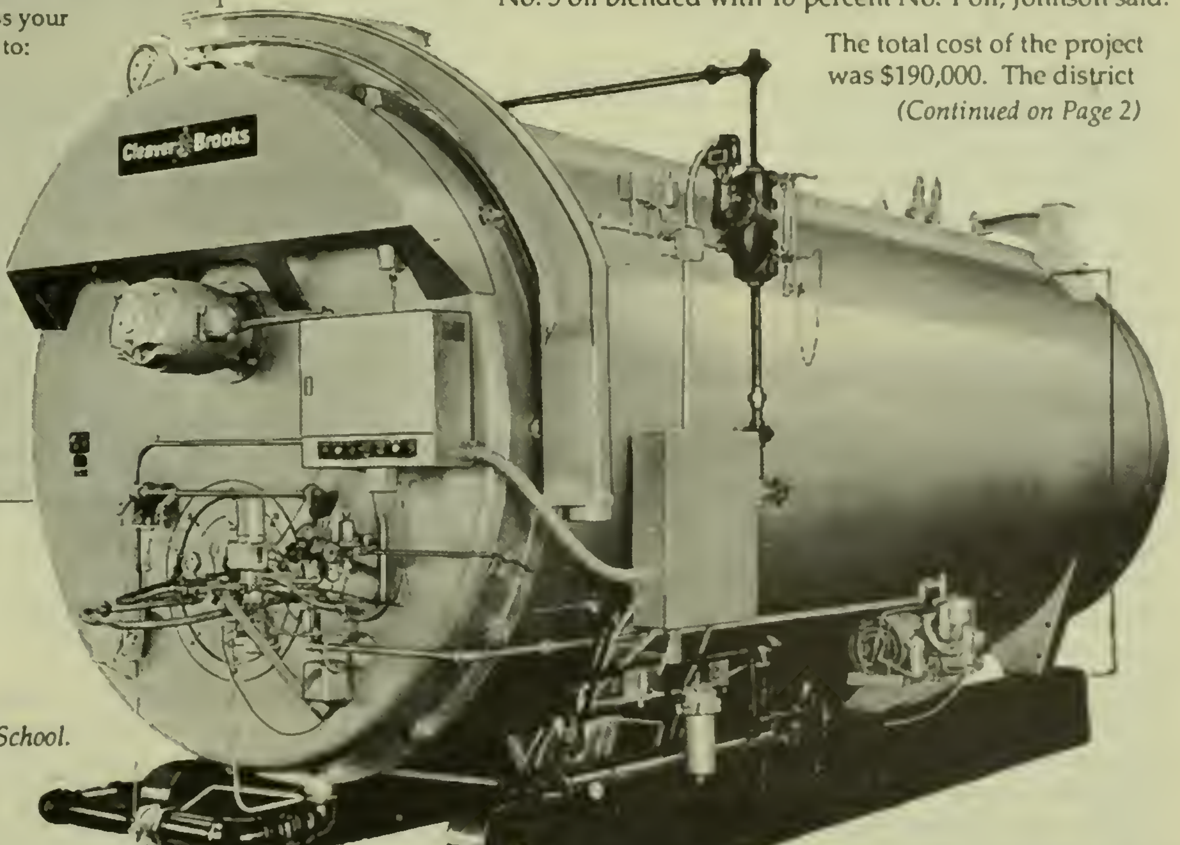
The Great Falls School District expects to achieve approximately a 17.6 percent return on investment on the new 250-horsepower, dual-fuel boiler it recently installed at the Great Falls High School.

The new boiler, which burns either natural gas or fuel oil, replaced the school's two operating boilers, according to Nobby Johnson, district supervisor for buildings and grounds. The old brick refractory boilers were installed in the 1930s and had fallen in efficiency to around 40 or 50 percent.

The new boiler, built by the Cleaver-Brooks Company of Milwaukee, Wisconsin, was installed in January 1989. It has a performance rating of 84 percent on natural gas and about 85 to 86 percent on a mixture of No. 5 oil blended with 18 percent No. 1 oil, Johnson said.

The total cost of the project was $190,000. The district

(Continued on Page 2)



The new boiler at Great Falls High School.

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Great Falls School (continued)

received a $90,000 Institutional Conservation Program grant from the Department of Natural Resources and Conservation (DNRC) to help pay for the purchase and installation of the boiler.

The payback on the job is expected to be between three and four years. Johnson said that "the payback was extended because of $130,000 in construction work needed to renovate an old coal storage bin to house the new boiler." The new boiler is approximately 22 feet long and 6 feet wide. He said it was too big to fit into the high school, so a separate facility had to be built in the coal storage bin under the parking lot. This involved cutting off the top of the storage bin and pouring concrete around the sides of the coal bin. A roof was then added. Johnson estimated the payback without the installation costs would be "about two years."

"It might seem that $130,000 is a lot for the construction costs to get the new boiler in the school," he said, "but older schools and institutions will find that when boiler replacement time comes, it's going to take some engineering and creativity. I don't think that amount is so unusual in this kind of situation."

Current savings data indicate the district will save around $31,600 a year in gas and oil costs compared to fuel costs from operating the old boilers. That is an approximate 23 to 24 percent reduction in heating costs, he said.

Johnson attributes part of the project's success to the design work and technical analysis performed by Drapes Engineering of Great Falls. James Talcott Construction, Inc. of Great Falls installed the boiler. As part of the job, the condensate return line and steam supply lines to the building were retained, but a new boiler feed pump was installed.

During this year's bitter cold in February, Johnson said it cost $6,829 to heat the high school with the new boiler. It would have cost $14,471 to heat the building for the month with the old boilers. DNRC data indicate the new boiler cut the district's Btu usage per square foot per degree day in February from 11.8 in 1988 to 3.9 this year.

Based on a story featured in Energy User News, August, 1989.

Group Relamping: Is It Right for Your Building?

Most building operators have heard of group relamping, but they may not know all of its benefits. For many large offices, warehouses, or retail stores, group relamping is often the most economical way to maintain a lighting system and keep energy costs low.

Why consider group relamping?

Decreased Labor Costs. Replacing lamps as they burn out can be very costly. It may take up to 30 minutes per lamp to get all the equipment and material assembled. Group relamping can require as little as three minutes per lamp.

Increased Buying Power for Lamps/Ballasts. Ordering lamps or ballasts in large quantities can yield significant volume discounts. While large purchases can be made without group relamping, valuable storage space is often lost until the lamps or ballasts are needed.

Fewer Interruptions of Building Occupants. Group relamping can be scheduled during holiday or non-working periods when tenants don't have to be disrupted. Group relamping doesn't eliminate the need to replace burned out lamps during business hours, but it substantially decreases the frequency.

Easier Cleaning and Replacement of Fixtures. While lamps are being replaced, the fixtures can be cleaned, old yellowed diffusers replaced, and other repairs made. Depending on the cleanliness of the environment, cleaning may only be necessary every other time you replace lamps. Benefits of cleaning may be particularly noticeable in smoking areas or if the building has return air fixtures.

Improved Luminaire Appearance. Group relamping means all lamps are replaced at the same time. This eliminates having old blackened lamps combined with new bright lamps or cool white and warm white lamps in the same fixture.

Elimination of Unnecessary Fixtures. By using group relamping, average lighting levels increase. Also, it may be possible to maintain the desired lighting levels with lower output lamps, removal of fixtures, or delamping. Any one of these strategies would lower energy use and reduce your utility bill.

How frequently is relamping needed?

For most fluorescent systems, the best time to group relamp is between 65 and 75 percent of average rated lamp life. The actual choice depends on the cleanliness of the environment and the amount of time lamps are left on.

Dear Readers:

We wish to thank those who responded to the survey accompanying the June *Energy Source*. We offer *Energy Source* in an attempt to meet the energy information needs of Montana's building operators. You are a diverse group and we need input to help us meet your wide range of needs. If you haven't yet responded to the survey, we'd still like to hear from you.

Many people offered suggestions for future articles. Some ideas mentioned were stories on boiler water treatment, boiler control systems, electronic motor starters, Q tubes, large swamp coolers, night set-back thermostats, refrigeration systems, and new lighting products and strategies. We plan to feature articles on several of the topics mentioned as quickly as we can gather current and reliable information.

We've had requests for a general timetable of our upcoming training sessions. We'll soon be setting up a master schedule of our workshop offerings for the next nine months. We'll make this overall schedule, including tentative dates and locations, available to you in an upcoming issue. In future editions, we'll continue to highlight each series of workshops as it approaches.

A few people expressed concern that some workshops are offered only in western Montana. We try to spread the workshops throughout the state, so that folks in the eastern and western regions have access to a variety of training. However, the Bonneville Power Administration often sponsors many of DNRC's energy-related workshops. Bonneville provides us with funds to conduct training regarding electrical conservation only in its service area, which is in the western part of the state.

Occasionally, DNRC receives requests to hold a workshop in a certain locale. We like to respond to these requests whenever it's possible. However, we often don't have the budget to cover the expenses. It would help if the party requesting the workshop could provide some of the funds or arrange a co-sponsor, but this isn't a requirement. Also, the workshops would be more feasible if the person or institution with the request can guarantee a minimum attendance of 17 to 20 people. A local contact can be very helpful in making workshop arrangements and encouraging people in the community to attend.

The survey provided DNRC with other useful information. About 75 percent of the respondents said they read most of the stories in almost every issue. The technical tips articles seemed to be the favorite, with stories about O&M items and studies about conservation efforts in Montana buildings also ranking high. About 50 percent of the respondents said *Energy Source* has helped in undertaking a technical tip, attending a DNRC energy workshop, or talking with a co-worker or manager about energy savings in their building. A range of one to twenty-eight people see each copy of *Energy Source*, and the average number of readers per office is two.

Finally, a thank you goes out for all the positive comments about *Energy Source*. We appreciate your support.

Peggy Nelson

Peggy Nelson
DNRC

Free Training On Videocassettes Available

DNRC's Energy Division offers videotapes designed for owners and operators of commercial and institutional buildings. These videotapes cover various aspects of energy management and operating procedures. They also provide an excellent follow-up to DNRC workshops.

DNRC will loan the tapes to you, free of charge, one or two at a time. They must be returned to DNRC within two weeks. DNRC will pay the cost to ship them to your organization, but we ask that you pay the return postage. All videotapes are 1/2 inch VHS format.

An order form is provided below. Indicate which tape(s) you wish to view and when you would like to use them. Please fill in the number that appears at the start of each entry.

From Oregon State University.
001 **Safe and Efficient Boiler Operations**, 1987, 36 minutes, with handbook. Shows how to save money on fuel, repairs, and other operating costs for small boilers.

From E.T. Harlow Co.
002 **Unit Ventilator Reconditioning**, 22 minutes. Looks at operation and maintenance of unit ventilators with face and by-pass dampers. Covers cleaning, re-gasketing damper blades, and adjusting damper linkages.

003 **Boiler Maintenance, Operation, and Safety**, 30 minutes, with handbook. Covers operating characteristics and safety controls for atmospheric and power burner boilers.

004 **Economizer Testing and Tune-up**, 30 minutes. Demonstrates methods for adjusting make-up and return air dampers in an HVAC system.

005 **Hot Water Reset For Hydronic Heating System**, 17 minutes, with handbook. Describes a hot-water system, water reset control, and three-way mixing valve. Techniques for checking set points and proper operation of the reset control are demonstrated.

006 **Multizone Hot Deck Controls**, 17 minutes, with handbook. Describes components of multizone air handling system, including resetting the hot deck temperature based on outside temperature.

007 **Guidelines for Steam Trap Troubleshooting**, 19 minutes. Outlines how to establish a preventive maintenance program, emphasizing testing of various traps.

008 **Solving the Water Hammer Puzzle**, 24 minutes. Discusses causes and effects of water hammer on a steam system, and prevention strategies.

009 **Guidelines for Steam System Efficiency**, 15 minutes. Discusses piping techniques necessary to achieve optimum efficiency.

*010 **Let's Talk Steamtraps/Update**, 1984, 32 minutes. Discusses operation of steam traps, focusing on inverted bucket, thermostatic, disc, and differential condensate controllers.

*011 **The Anatomy of the I.B.**, 15 minutes. Uses a glass model to look at the performance and components of inverted bucket steam traps.

*012 **Guidelines for Steam Trap Repair**, 1988, 20 minutes. Outlines different types of steam traps, gives techniques for repairing each, and shows how to spot faulty ones.

*013 **Guidelines for Steam/Air Coil System Design**, 1988, 13 minutes. Explains causes of frozen steam coils and the steps to take to prevent problems.

From Illuminating Engineering Society
*014 **Lamps and Luminaires**, 1982, 20 minutes. Talks about energy saving lamps, including high intensity discharge, and warm and cool renditions.

*010 - *014 are new offerings.

VIDEO ORDER FORM

NAME ____________________ ORGANIZATION ____________________

ADDRESS or P.O. ____

CITY, STATE, ZIP ____________________ WORK PHONE ____________

PLEASE SEND THE FOLLOWING VIDEOTAPE(S):

1. ____
2. ____
3. ____

Preferred date of receipt ____________________

Return form to: DNRC, Energy Division; 1520 East Sixth Ave.; Helena, MT 59620-2301

Technical Tips

Filters on HVAC Equipment

The importance of changing filters regularly on HVAC equipment can not be over stressed. This simple but sometimes tedious job can lower energy usage by 20 percent or more, and prolong the life of expensive equipment.

A common myth about filters is that they are clean and working properly if they look clean. This is not true of the most common types of filters, "impact" filters.

Impact filters are usually made of fiberglass and are disposable. There is a film of oil on impact filters which catches dust and dirt particles; the film is activated once the plastic packaging is removed. The film lasts four to six weeks after it has been exposed to air. Therefore, it's important to be sure that impact filters are sealed until they are installed. Then, they should be changed promptly every four to six weeks, even if they look clean. A general rule-of-thumb for impact filters is that if a filter looks dirty, then it should have been changed much earlier.

"Bag" filters catch dust and dirt particles on a film, through surface attraction, and by trapping particles in the filter pleats. These filters do not have to be changed as often as impact filters.

Bag filters look dirty after two weeks. Most bag filters are installed in systems which have a manometer that measures the static pressure of the flow of air through the filter. If the static pressure drops to a predetermined point, the filter needs to be changed.

If the static pressure limits are not in your manual, find someone—preferably certified by the National Environmental Balancing Bureau (NEBB)— who can calculate the limits and write them down beside the manometer. Also, it helps to place some tape or otherwise mark the manometer at the location where the filter should be changed.

There is a common perception that dirty filters can reduce energy use. A dirty filter actually does cut back on the energy use on the fan motor by decreasing the air flow. However, a dirty filter also can cause the static pressure to rise. Then the fan needs more horsepower to move the same amount of air through that dirty filter.

A dirty filter will also require hotter and colder water for heating and cooling the air. Keeping the filters clean will help slow down the blower rpms and move the same amount of air through the duct, thereby saving energy.

When you purchase new filters, follow the specifications given by the equipment manufacturer on size and material. Deeper pleats increase the life of the filter. Also, less expensive filters will not last as long as better quality ones.

Have questions about energy?

For Free Help, Call NATAS in Butte

The National Appropriate Technology Assistance Service (NATAS) is funded by the U.S. Department of Energy. NATAS has an extensive resource center and an experienced staff who are ready to help people find the energy information they need.

Since 1984, NATAS has responded to more than 40,000 requests. NATAS staff provide tailored information over the phone, by sending letters that enclose relevant articles, reports, and suggested reading lists, or by referring requests to other sources for specific information.

NATAS offers technical information on planning energy systems, troubleshooting, safety procedures, installation methods, and comparisons of various designs and components. Also, NATAS staff prepare material about renewable resources, such as solar, wind, hydro, biomass, geothermal, cogeneration, and waste-to-energy systems.

NATAS also offers business assistance ranging from marketing advice for inventors to cost-control plans for businesses looking to trim their energy budgets. NATAS specialists have worked with businesses, schools, churches, and hospitals to provide services that include researching innovative financing options for heating systems and looking at insulation strategies.

NATAS is available to anyone in the United States and is free to the user. Montanans can reach NATAS by calling weekdays between 8 A.M. and 5 P.M. at (800) 428-1718, or writing to: NATAS, P.O. Box 2525, Butte, MT 59702.

Preventive Maintenance for Controls

The operation and maintenance of controls should follow the manufacturer's recommended procedures for each control component. The following components are frequently overlooked in maintenance programs.

Thermostats. You should clean these devices at least twice annually. Dirt accumulation causes "overshoot" and "undershoot" and contributes to excessive energy use. Calibrate and adjust your thermostats to be sure they give true readings.

Pneumatic Devices. All pneumatic devices must have a clean and dry air supply to operate correctly. Clean filters and traps regularly according to manufacturer's instructions. Lubricate pistons as recommended by the manufacturer.

Timeclocks. Routinely inspect for alternation of settings and for correct time. Timeclocks vibrate constantly, which causes the trippers to come loose, slip, and finally just slide to the bottom of the face. These devices can operate for years without basic maintenance, but need almost constant surveillance and should be reset after power outages.

Some programmable timeclocks require a battery change annually. Check with the manufacturer.

Photocells. Photocells are usually maintenance free. However, they should be checked periodically to keep uncovered photocells clean. Birds often cause problems with exposed outdoor photocells.

Electronic Devices. Call a professional if a malfunction is suspected.

Gas Valves and Controls. At no time should the gas solenoid valve be held open. Don't block any controls in an open or closed position. Also, boiler and hot water heaters should be tested to make sure they are tuned-up to maximum combustion efficiency.

New Training Videos

DNRC has recently added five new titles to its videotape library. They are:

Let's Talk Steamtraps—Update
The Anatomy of the Inverted Bucket
Guidelines for Steam Trap Repair
Guidelines for Steam/Air Coil System Design
Lamps and Luminaires

See the insert in this issue for more information.

Upcoming Events

The **12th Annual World Energy Engineering Congress** is scheduled for October 25-27, 1989 in Atlanta, Georgia. DNRC's Bill Younger and Wayne Turner of Oklahoma State University will present a one-day seminar on the latest strategies in commercial building energy management.

A seminar on the **DOE2.1C energy simulation computer program** is being held October 23 and 24 in Missoula. DOE2.1C (pronounced "doe two") is a public domain computer program that can be used to approximate the energy performance of proposed or existing buildings. Co-sponsored by DNRC and the Bonneville Power Administration, this two-day session is aimed at architects, engineers, and building owners and managers. Participants are expected to know how to use computers, understand energy simulation, and be familiar with principles of architecture and HVAC systems. **Pre-registration is required**; the number of participants is limited. The cost is $35.

For more details about these events, contact DNRC.

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Inside...

The Department of Natural Resources and Conservation welcomes you to its periodic bulletin, *Energy Source*. The sixth issue highlights:

- Eureka Library conservation measures
- Ways to save on air conditioning costs
- Troubleshooting tips for chillers
- When to turn off fluorescent lights
- Readers' survey

Funding for this issue is provided by Bonneville Power Administration. We encourage our readers' comments. Address your correspondence to:

Peggy Nelson
Department of Natural Resources
and Conservation
1520 East Sixth
Helena, MT 59620-2301
444-6697

Eureka Library Cuts Energy Bills and Improves Comfort

By adding insulation to the roof and walls, the Lincoln County branch library in Eureka turned cold into comfort and cut its energy bills by more than half.

According to librarian Esther Brandt, the library used to be "cold and drafty all winter. Our heating system just couldn't keep up with the weather. The county clerk used to call and say 'You must be keeping it pretty warm up there' because the energy bill was so high for such a small building." In fact, the library was costing the county over $1,300 a year in energy bills alone, and that drain on funds already in short supply threatened to curtail the library's operating hours. In hopes of reducing the library's energy consumption, the county conducted an energy study on the building with the help of a $354 grant from the Bonneville Power Administration.

Engineers from Brinkman and Lenon, Inc., of Kalispell examined all the energy uses in the 1,440 square foot, single-story building. The library relies on electricity for all of its heating and lighting, which includes baseboard heaters, fluorescent ceiling lights, and a small water heater for the rest room. Because energy use is limited to fairly essential purposes, and because the library is open no more than 20 hours a week, improvements in the operation and maintenance procedures reduced energy consumption by only one percent. What the library really needed, the engineers found, was more insulation in the roof and walls.

The flat roof, dating from the building's construction in 1970, had developed a water leak and was due to be replaced with a pitched roof. The initial bids for the work, which included installing a metal roof and cedar siding, were too high for the county's budget. To cut costs, commissioner Noel Williams, a Eureka resident, revised the retrofit plans to rely on less expensive construction methods and materials.

Lincoln County Library in Eureka

(continued on page 2)

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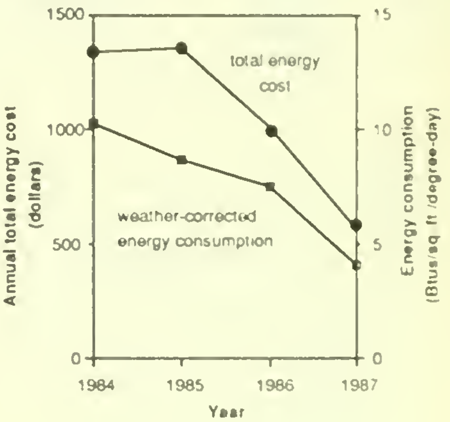
(Eureka Library, continued)

Williams also recommended using in-house labor on the project. The county commissioners decided to insulate the roof during the reconstruction and applied to the Department of Natural Resources and Conservation (DNRC) for a grant through Bonneville's Institutional Building Program to cover the cost of the insulation.

In October 1985, the pitched roof was added and insulated to R-30 with blown-in cellulose. Insulation costs were $1,028. In December 1986, R-19 rigid foam insulation was applied to the inside of the cinder block walls and covered by drywall. The insulation, drywall, and finishing costs for the walls came to $6,446. The total cost for insulating the library came to $7,474, with $4,970 funded by Bonneville and the remainder contributed by Lincoln County.

DNRC has tracked energy consumption at the Eureka library since the retrofit was completed and has compared the results to baseline data collected during the energy audit. In 1984, the library consumed 32,810 kwh. After the roof was insulated, energy consumption dropped to 22,890 kwh in 1986. With the added insulation in the walls, 1987 consumption was reduced to 11,830 kwh. Energy consumption had been cut by 60 percent compared to 1984 levels.

Eureka Library
Energy Consumption and Energy Costs



The library's utility bills reflected the savings, dropping from $1,340 in 1984 to $570 in 1987.

"If I hadn't been here for the last six years I probably wouldn't have given much thought to how comfortable the library is now," says librarian Brandt. "There's a tremendous difference. Remembering how cold and drafty it was, or hot in the summer, this is a great improvement in comfort." Brandt says she has the thermostats set at 65 degrees F and rarely needs to adjust them, even on the coldest days.

The library patrons are noticing the change, too, says Brandt. "It was hotter than usual up here last summer, and then we had that severe cold spell in February. Whatever the season, people come into the library and say, 'Boy, it feels good in here!' They notice the contrast to the outside temperature."

Most important, cutting back the energy bill has allowed the library to maintain its operating hours despite a shortfall in the county's mill levy in 1985. The Lincoln County libraries are on a tight budget, but conserving energy keeps them open 51 weeks a year.

Technical Tips: Troubleshooting Your Chiller

Troubleshooting for too low or too high chilled water temperatures should begin when the system is fully loaded and operating at full capacity. If the temperature is too high, the chilled water and/or condensing water system is most likely experiencing some of the following problems:

1. The pump is cavitating. Listen for a sucking or grinding noise in the pump. A cavitating pump means trouble. Contact a maintenance engineer.

2. The chilled or condensing water line is too restricted by the metering valve. The chilled or condensing water strainers are clogged. Clean them out.

3. There is dirt or excessive scale in the chiller's heat exchangers. The chiller will require servicing. Scale build-up is the result of poor water treatment. Water treatment chemicals color the water. If the condensing water is clear, most likely it is not treated. Keep a sample of properly treated water in a jar nearby, so you can compare it with the water in the chiller.

4. The cooling tower may not be doing its job. If the condensing water temperature is too high, check to see if water is flowing well over the slats. Verify that the fan is operating.

5. The chiller may be malfunctioning if the chilled water supply and return temperature are too high. In reciprocating chillers, high water temperatures suggest that one or more compressors are bad or that a refrigerant leak is present. Also, chilled water supply and return air temperatures may be too high. In either case, servicing will be required.

Reader Survey

This is the 6th issue of *Energy Source*. The DNRC Energy Office is reviewing the newsletter to see how it can be made more useful to its readers. Please fill out and mail the following survey.

1. How often have you read *Energy Source*?
   - Every issue___
   - Almost every issue___
   - Occasionally___
   - This is 1st time___

2. How completely do you read the newsletter?
   - Read it entirely cover-to-cover___
   - Read most of it___
   - Read selected articles only___
   - Quickly glance through it___

How many other people in your office read *Energy Source*?________

3. Check the types of features in *Energy Source* you are likely to read:
   - Feature articles___
   - DNRC announcements___
   - Workshop announcements___
   - "Technical tips"___
   - Availability of video tapes___
   - Operations and maintenance articles___

4. Has receiving *Energy Source* helped you to:

	YES	NO	MAY IN FUTURE
Order an energy management video tape	_____	_____	_____
Order an energy management publication	_____	_____	_____
Attend an energy management workshop	_____	_____	_____
Request technical information from a state employee	_____	_____	_____
Contact other building operators about energy management	_____	_____	_____
Implement a "technical tip" to save energy	_____	_____	_____
Discuss energy savings possibilities with other workers	_____	_____	_____
Talk to building manager or owner about possible energy savings	_____	_____	_____
Start an energy management plan	_____	_____	_____

5. Would you like to continue to receive *Energy Source*?

Yes___ No___

6. Do you know of others who would like to receive *Energy Source*?

Name ____________________ ____________________

Address____________________ ____________________

City/Zip____________________ ____________________

7. You work for a:
   - state agency___
   - local government___
   - school district___
   - hospital___
   - utility / elect. co-op___
   - private company___

8. Are you a:
   - building owner___
   - building manager___
   - maintenance officer___
   - utility rep.___
   - consultant___
   - other(expl.)________________

9. Are there subjects you would like covered in future issues, or do you have other suggestions for improving the newsletter? (Continue on reverse side if necessary.)

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Cool Down Your Energy Bill

You can achieve significant energy savings by turning up the thermostat on your air conditioner. In fact, you'll save more for each degree you raise the air conditioned temperature than you obtain from lowering the thermostat on the heating system.

You'll want to change the air conditioner settings gradually, perhaps a degree every week or so. (This goes for the heating system, too.) Changing the settings slowly gives people time to adjust to the new temperatures. Visitors coming in from the warm outside air will still feel a welcome contrast, even though the indoor temperature is higher than it used to be.

Experiment to see how high the settings can be without causing discomfort. You'll need to consider the activity level of your building's occupants. People who work at desks, for example, usually tolerate a higher temperature than individuals performing manual labor.

Good air circulation reduces the need for cooling. Ventilation keeps temperatures even and prevents cool air from collecting in a layer near the floor. Circulating air promotes cooling by evaporating moisture from the skin, supplies fresh air, and decreases drowsiness that occurs if the air is stale and warm.

Remember, running a fan is cheaper than running an air conditioner. If your building's windows open, you may want to turn the air conditioner off and open some windows on nice days. Generally, people are comfortable at 68 degrees in winter and 78 degrees in summer.

Energy-Saving Actions for Cooling Systems

Decrease operating hours. This is one of the most effective means of reducing energy consumption. Often, savings can be accomplished by using manual controls.

Check water temperatures. Evaluating the temperatures of chilled and condenser water is like monitoring a patient's vital signs; high or low temperatures can indicate problems. (See the Technical Tips in this issue.)

Determine water flow requirements. Frequently, too much water flows through the chiller, increasing both pump and compressor energy requirements. Analyze actual flow rates needed and reduce them whenever possible.

Turn off chiller system auxiliaries during unoccupied hours. Care must be taken to ensure that only non-essential equipment is turned off. When the chiller is off, circulation pumps, cooling tower fans and several other items may be turned off.

Calibrate and adjust your thermostats to ensure accurate readings. The room thermostat is the overriding control and may keep chillers operating longer than necessary.

Use existing demand limiters. Most of the existing centrifugal chillers have this cost-saving feature. Savings result when the unit is not allowed to run at full load during the facility's hours of normal peak load operation.

Increase the chilled water supply temperature and decrease the condenser water temperature. Generally, a one-degree decrease in condenser water temperature yields a one percent decrease in operating costs. Similarly, a one-degree decrease in chilled water supply temperature yields a one percent increase in operating costs. Check the manufacturer's literature prior to decreasing the condenser water temperature in an absorption unit. The system is more efficient at higher chilled water temperatures.

Increase the suction temperatures. Suction pressures may be adjusted to raise suction temperatures.

In a parallel arrangement, each installed chiller unit should be able to establish its own chilled water temperature. When the load is reduced by shutting down one or more chillers, do not allow water from the off-line units to mix with water in the operating units. This consumes more energy than necessary, since water is cooled lower than required to compensate for mixing with uncooled water.

In a series arrangement, the load should be equally reduced or raised on each chiller unit to meet the requirements for units installed in series.

Training Cassettes Are Popular

In several previous issues of Energy Source, we've included a listing of videocassettes that are available from DNRC. The cassettes provide energy management training on topics of interest to building operators, managers, and owners.

The response to the loan program for the videocassettes has been excellent. In some cases the demand has been so great that we now have a two-month waiting list. We have purchased extra copies of the most-requested titles, and these too are now out on loan. If you presently have a training cassette, please return it promptly so we can send it to those on the waiting list.

Currently, we're reviewing additional videos for inclusion in our lending library. Watch for the updated list of offerings that features our new, expanded inventory in the next issue of Energy Source.

Should You Leave Your Fluorescent Lights On?

Many people think fluorescent lights should not be turned off frequently because restarting a lamp uses more energy than keeping it lit, and turning a lamp on and off decreases its lifetime. Both reasons are misconceptions. Almost without exception, you save energy and money by turning off fluorescent lamps when they are not needed.

Restart Energy

Does a fluorescent light have to be turned off for a half hour before the energy saved equals the energy used to initially energize the lamp?

Many commercial building tenants think so, but this isn't true. The total starting current to a lamp lasts for about one second. The initial in-rush current lasts for only one-half cycle (1/120 second), and has a peak value about five times as large as the steady-state peak. This in-rush current does not use a significant amount of energy since it lasts for such a short period.

Thus, fluorescent lights only have to be turned off for one second to save the amount of energy used when the lights are initially turned on.

During summer, turning off fluorescent lamps is a particularly good idea, because heat from the lights often contributes significantly to a building's cooling load.

Lamp Life

But don't you lose anyway because turning the lamp on and off significantly decreases its lifetime?

The lifetime of a fluorescent lamp depends on the filament's electron emissive coating; each time the lamp is started, some of that coating erodes. In the 1950s and 60s, when electricity prices were low and rated fluorescent lamp life was much less than today's lamps, leaving lamps on when areas were unoccupied may have made sense. Today it doesn't.

A recent study by the National Research Council of Canada demonstrates "both money and energy will be saved if standard or energy-efficient fluorescent lamps are turned off at night, at lunch, during coffee breaks, and, in general, whenever they are not needed."

The study examined a wide range of lamp and ballast combinations as well as switching schedules and assumed a relatively high price for replacement lamps. They found that even at three cents/kwh, leaving lights off for more than 15 minutes yielded a net money savings.

Taken from: "Turn Off the Lights," "Techdata Sheet", U.S. Department of Energy, January 1980, and "Economics of Switching Fluorescent Lamps" by L.A. Carriere and M.S. Rea, National Research Council of Canada, November 1985.

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May 1989

Inside...

Welcome to the Department of Natural Resources and Conservation's periodic bulletin, *Energy Source*. The fifth issue features:

- DNRC's Pumps and Motors workshops
- Energy Accounting workshops
- Anaconda City Hall retrofit
- Tips for air intake monitoring
- Library of commercial videotapes
- Hints about motors

Sponsors for this edition are the U.S. Department of Energy and Bonneville Power Administration. We encourage our readers' comments. Address any correspondence to:

Peggy Nelson
Department of Natural Resources
and Conservation
1520 East Sixth
Helena, MT 59620
444-6697

Energy Retrofit Preserves Historic Building

The Copper Village Museum and Arts Center is a fine example of an energy saving retrofit in a historic building, according to Fred Quivik, an architectural historian with Renewable Technologies Inc., of Butte. Quivik helped design the retrofit that turned the abandoned Anaconda City Hall into a warm, comfortable home for a lively arts and cultural center.

When it was built in 1894, the Anaconda City Hall was "the finest city hall in the Northwest." It housed the police and fire departments as well as the city offices until 1976, when the city and county governments consolidated and all government offices were moved to the County Courthouse.

The vacant city hall became dilapidated. The local redevelopment agency wanted to sell the building to a developer who planned to tear it down and put up a shopping mall. But a group of local history buffs led by Alice Finnigan saved the Anaconda City Hall from the wrecker's ball with a court injunction. The Tri-County Historical Society, Anaconda Cultural Association, and Copper Village Museum and Arts Center took possession of the building in 1982. They hired Quivik and architect James McDonald of Missoula and began raising funds for the renovation.

(continued on page 2)

Anaconda's Copper Village Museum and Art Center

PLEASE RETURN

(Energy Retrofit, continued)

To make it economically feasible for non-profit organizations to operate the building, they asked Quivik and McDonald to do everything they could to keep future energy costs down. Quivik and McDonald used computer simulation to help decide which energy conservation measures would be most effective.

The amount of energy the building used in 1973 and 1974 when it was in full operation would have cost nearly $10,000 a year at today's rates. Quivik and McDonald cut the building's heating bills an estimated $4,700 by installing thermal windows and doors, adding insulation in the attic and walls, and reducing infiltration. They cut the heating bills another $1,700 a year by replacing the 64 percent efficient boiler with a new 86 percent efficient boiler.

A grant from the Montana Department of Natural Resources and Conservation paid for some of the energy conservation measures as a demonstration project. The grant helped pay for blowing R-40 fiberglass insulation into the attic, adding R-15 insulation to the walls, and setting up infiltration barriers in the cavities created by the flooring and partition assemblies. "We wanted to demonstrate that substantial energy conservation measures can be taken without damaging the historical character of a building," Quivik explained.

Maintaining the shape and scale of the windows is important to the exterior of old buildings, he said, adding that the new thermal windows look much the same as the old ones. "The extra effort was really worthwhile," he said.

Maintaining the historic character of the building also required care in the detailing. To preserve the original masonry walls, most of the exterior walls were insulated on their interior face, Quivik said. The interior wood trim was carefully removed and then reapplied after the insulation and new windows were installed.

The art gallery and gift shop located in the restored building opened in August, 1988. "We figure about 5,000 people came through between August and December 31," said Carol Jette, director of Copper Village Museum and Art Center.

Copper Village offers a full schedule of workshops covering watercolors, oils, sculpture, tole painting, smocking, and needlepoint. A quilters' group meets there each Thursday morning.

Plans call for a restaurant and a community theater-reception area on the second floor. A local woman

(continued on page 4)

Anaconda City Hall Wall Insulation Techniques

Wood furring (2 x 2- inch) at 16 inches on center was applied to the interior face of the brick wall and filled with a rigid insulation panel of polyisocyanurate foam with an aluminum foil face. The thickness of the insulation varied from 3/4 to 1 1/2 inches depending on the existing construction. Regular 1/2-inch gypsum board was applied over the insulation board. Metal trim and taped joints completed the assembly and provided a finished interior surface ready for sealing and painting.

Where the edges of the insulation butted existing masonry or other existing construction details, sealant was applied to form an infiltration barrier. In a similar manner, the edges of the gypsum board were caulked when abutting existing construction.

Adding rigid insulation to the interior wall required changes in the window installation. Jamb extensions were installed to fill in the deeper window wells. The new jamb also provided a surface to set the rigid insulation against a sealant bed. The wood trim was carefully reapplied.

The east and south facades of the city hall were stucco over the original masonry. These areas received an assembly of rigid insulation board or fiberglass mesh and a finish coat simulating stucco. To prepare the existing surface for the material, the trim, surface-mounted utilities, and deteriorated stucco were removed, and the surfaces were leveled with stucco on wire lath.

A single three-inch layer of expanded polystyrene foam insulation board was mechanically fastened to the stuccoed brick. A fiberglass matt was embedded in a wet coat and covered with acrylic finish. This provided the final texture and color.

The exterior walls were finished with flashing, base drip screens, corner beads, control joints, and caulking. Trim and exterior fittings were reapplied. The completed assembly adds an R-value of 14.51 to the original wall.

Free Training On Videocassettes Available

DNRC's Energy Division offers videotapes designed for owners and operators of commercial and institutional buildings. These videotapes cover various aspects of energy management and operating procedures. They also provide an excellent follow-up to DNRC workshops.

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VIDEO ORDER FORM

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3. ______________________
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Preferred date of receipt ______________________

Return form to: DNRC, Energy Division; 1520 East Sixth Ave.; Helena, MT 59620-2301

MOTORS AND PUMPS WORKSHOPS

TIME: The Motors and Pumps workshops will run from 1:00 P.M. to 4:30 P.M.

PLACE:	DATE:
Dillon Western Montana College Office Classroom Building Room 302	Thursday, June 15
Missoula Montana Power Company Meeting Room 1903 Russell	Friday, June 16
Cut Bank Glacier Electric Co-op Meeting Room 410 East Main	Thursday, June 29
Kalispell Flathead Electric Co-op Meeting Room 2510 Highway 2 East	Friday, June 30

ENERGY ACCOUNTING WORKSHOP IN DILLON

TIME: The Energy Accounting workshop will run from 8:30 A.M. to 12:00 noon

PLACE:	DATE:
Western Montana College Office Clasroom Building Room 302	Thursday, June 15

Participants, don't forget to bring 12 months of energy bills , a calculator, and a computation of the total heated area for your building. DNRC staff will assist you in setting up a personalized file for your facility.

Energy Division, DNRC
Lee Metcalf Building
1520 East Sixth Avenue
Helena, MT 59620-2301

There is no charge to attend DNRC workshops. However, we request that participants pre-register for the workshops by calling Jody Nugent at 444-6697. If too few people pre-register, these sessions could be cancelled.

Technical Tips

Monitoring Outside Air Intake

Outside air has to be heated or cooled. If it's air you don't need, it uses energy and dollars. To check the percentage of outside air coming in, you'll need to measure the outside, return, and mixed air temperatures. The tools you'll need are a thermometer that reads in tenths of a degree, duct tape, and supplies to fix possible leaks.

Before starting, find out what the legal requirements or recommended percentages of outside air are for your type of building. Your building code inspector or design engineer should be able to tell you.

Getting Ready

First, make sure there are no air leaks in the air handler. Leaks often occur at doors where gaskets are missing, where bolts are missing from panels, or where piping for coils enters the air handler.

Then, repair all leaks. Make sure the damper linkages for the outside air intake are working properly. Inspect the connections and test any damper positioning controls on the air handler panel. Look inside the air handler to verify that the damper linkage is working properly. Inspect both minimum and maximum damper positions.

A videocassette that talks about adjusting damper linkages is available from DNRC's Videotape Library. It's called "Unit Ventilator Reconditioning." See the insert in this issue for more information.

Accurate temperature measurements are important. To get a true reading, follow the steps below. If mixed and return air temperature sensors are located on the panel, verify that they are properly calibrated. If they are, you can use these temperatures to determine your outside air percentage.

Doing the Work

Jot down the air handler being tested, describing it by location or number. Measure and record the temperature of the return air, outside air, and mixed air. Here are some hints:

1. The further downstream from the mixed air plenum that mixed air temperatures are taken, the better. Filter banks and coils tend to mix the two air streams, so you get better measurements. If measurements are taken downstream from coils, their valves should be completely closed. They shouldn't leak. If you close off the coils, wait five minutes before measuring.

2. If readings are taken anywhere ahead of the fan, take several. Take one reading for every 2 or 3 feet of ductwork.

3. If possible, measure temperatures at the mid-section of the duct. If not, make sure that your temperature measurements for return and mixed air are read at the same position in the ductwork.

Next, find the average by adding all your readings and dividing by the number of readings you took. Repeat this exercise by recording several more outside air and mixed air temperatures. This second round of readings will serve as a check.

To find the average of all the outside air readings, divide the total of all readings by the number of readings. You can also average all the mixed air readings. Then you can determine the percentage of outside air:

$$\text{OUTSIDE AIR} = \frac{\text{Return air - Avg. mixed air}}{\text{Return air - Avg. outside air}} \times 100$$

Motor Minders

Many premium motors have lower overall slip values than standard motors. This reduction in internal slip can result in higher running rpms. In fans and pumps this may lead to higher energy use. Rpms should be held constant through resizing of belts and sheaves.

Premium motors generally run cooler than their standard counterparts. Because of this, their insulation and bearings will usually last longer. However, all energy efficient motors are not created equal. Some manufacturers may claim that their motors are "energy efficient." Be cautious. Specify that you want a "premium" grade motor.

Occasionally a premium motor of equivalent horsepower to an existing standard motor will have a slightly larger frame size to allow for additional copper and other changes within. Check your frame tolerances before ordering a premium motor. If the motor is connected to equipment via belts, there may not be a problem.

Motors and Pumps Workshops Scheduled

During June, DNRC will sponsor four half-day workshops in western Montana for building operators. These free sessions will focus on preventative maintenance techniques for electrical motors and pumps. Topics will include operation, troubleshooting strategies, and other tips.

Jim Headlee and Greg Clouse of Northern Montana College will lead the workshops. Together, they have more than 20 years of experience in electrical and mechanical systems, and about 10 years in teaching seminars. For the past several years, they have been instructors for NMC's Diesel Technology program.

The workshops will be conducted in Dillon, Missoula, Cut Bank, and Kalispell and will be funded by the Bonneville Power Administration. (Dillon area residents should note that DNRC will hold a half-day Energy Accounting Workshop in Dillon on the same day as the motors and pumps training. The sessions won't pose a time conflict for those wishing to attend both.)

See insert for the dates, times, and locations. To pre-register, call Jody Nugent at 444-6697.

(Energy Retrofit, continued)

plans to run the restaurant, and Jette said she's already had calls asking about renting the reception area. "We're hoping to find some grant money to finish the work," she said.

Jette said the energy conservation measures are working even better than expected. "Our power bills have been considerably lower than was estimated," she said. "We have been pleasantly surprised."

– Pat Hoban, DNRC

Energy Accounting Workshop Set for Dillon

In June, DNRC will hold a free, half-day Energy Accounting workshop in Dillon (see insert) for building managers in southwestern Montana.

This session will show participants how to organize their building's energy bills, graph and analyze energy consumption, and establish realistic energy management goals for their facilities. Topics will include rate schedules, demand charges, and computer accounting software. The workshop will be taught by Bill Younger of DNRC.

Workshop participants are asked to bring a calculator and utility bills from the previous 12 months for their buildings. Attendees will need to compute the total heated area of their building and provide that figure (in square feet) at the workshop. During the session, you'll set up an energy accounting file for your building.

Participants are asked to pre-register for this session. On the same day, DNRC will host a half-day Motors and Pumps workshop in Dillon (see above article.)

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Inside...

Welcome to the Department of Natural Resources and Conservation's periodic bulletin, *Energy Source*. This bulletin provides practical information on energy management in commercial and institutional buildings. The fourth issue discusses:

- DNRC's upcoming Energy Accounting Workshops
- Accomplishments of the Montana State Hospital
- Energy saving ideas for hospitals
- Tips for electrical equipment
- Library of commercial videotapes

A thank you goes to the Department of Energy and Bonneville Power Administration for funding this edition. We encourage you to comment on the usefulness of our publication. Also, multiple copies are available on request. Address your correspondence to:

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444-6697

April Workshops to Feature Energy Accounting

DNRC Boiler Workshops Highly Rated

Over 230 people attended DNRC's five Boiler Optimization Workshops in January. Instructors Harry Taplin and Delmer Sneed offered practical information on ways to improve performance of boiler plants. Also, specific tips for boiler trouble-shooting and water treatment were presented.

Workshop participant Jim MacPherson, director of Western Montana College's physical plant, summed up the Butte session. "It was a good workshop that offered a lot of usable information,"he said. "People seemed to get a lot out of it." MacPherson and three staff members traveled from Dillon to attend the two-day session in Butte.

MacPherson takes his job seriously, and this attitude has paid off for Western in terms of dollar savings and natural gas usage. With the help of grants from DNRC's Institutional Conservation Program to finance energy conservation, MacPherson reduced the college's natural gas bills by $42,000 in 1988 compared to the base year 1984. This represents an actual reduction of 25.3 percent (weather-corrected) in gas consumption.

MacPherson states, "I think we'll see even more savings because of the ideas presented at the workshop. Our people have come back enthusiastic and are eager to try some of the techniques presented."

(Continued on Page 3)

Capital Improvements Are Next Step

Employees Lead the Way to Energy Savings

When the energy bill went over $1 million in 1983, the superintendent of the Montana State Hospital at Warm Springs arranged for a team of employees to tour the facilities to find out what could be done to save energy.

"We found that instead of turning off the heat, people were opening windows." said Tom McCarthy, the environmental services director. Another problem encountered was heating seldom-used space, such as in the gym at Galen, which was heated to 70 degrees even though it was used infrequently.

The team that toured the facilities became the Energy Committee and was made up of representatives of the various hospital departments. The ten-member team tackled the task of discovering what could be done to save energy.

(Continued on Page 4)

PLEASE RETURN

Eight Steps to Energy Savings in Your Hospital

1. Organize an Energy Management Committee.
The committee should have representatives from administration, maintenance, and each division of the hospital staff to ensure total cooperation. Energy-saving opportunities exist in all areas of operation. Engineering and maintenance personnel are the focal point of energy information because they operate and maintain the major energy-intensive systems in the hospital. An implementation team should also be organized and centered within the engineering and maintenance department to work with the energy management committee.

2. Set up a Preventive Maintenance Program.
A formal, documented program will ensure that all equipment gets the maintenance it needs on time. A formal preventive maintenance program starts with a list of all equipment that should be maintained and when it should be cleaned, lubricated, and tuned. When maintenance is performed, record the date for each piece of equipment. Properly maintained equipment works more efficiently and uses up to 20 percent less energy than poorly maintained equipment. Regular preventive maintenance can also keep repair costs low, minimize equipment malfunctions, and extend the life of your equipment.

3. Write an Operations Manual.
Just a single page for each piece of equipment in your operation may be enough. It should explain exactly how to operate and maintain the equipment. An operations manual is especially helpful when you have changes in personnel.

4. Have an Energy Audit.
An energy audit is an analysis of how your building uses energy. The audit report usually lists no-cost and low-cost steps you can take to cut your energy bills. The auditor will help you draw up an energy strategy, including identifying which actions will give you the best return on your investment. A more in-depth technical analysis would be advisable if you are doing extensive remodeling, buying expensive equipment, putting on an addition, or are planning to participate in conservation grant programs offered through DNRC. Lists of professionals that do energy audits and technical analyses are available through DNRC.

5. Keep a Record of Your Energy Consumption.
Hospital engineers should read gas, electricity, and water meters on the first of each month or make arrangements to receive all consumption information from utility bills. Monthly comparisons of energy consumption provide a basis for evaluating the success of the program and indicate any significant changes in energy use that may require corrective action. Many facilities find it easy and useful to enter data on a microcomputer spreadsheet for analysis.

6. Hold an Energy Workshop for All Your Employees.
Employee cooperation and participation are essential to a successful energy management program. Establish a formal program to instruct employees in the simple, day-to-day things that save energy. The energy management committee may want to consider the services of qualified consultants. A means should be established to encourage the submittal of energy-saving ideas, and recognition should be given to individuals who submit those ideas. Notices on bulletin boards, posters, and staff meetings help maintain the awareness and enthusiasm needed for an effective energy management program.

7. Consider Energy Usage When Purchasing New Equipment.
Initial cost of some energy-efficient equipment, such as motors, lights, and refrigeration, may be greater than the initial cost of less efficient equipment. Select new equipment on the basis of the total cost of buying, running, and maintaining it over its expected life rather than on the basis of initial cost only.

8. Consider an Automated Energy Management System.
Automated energy management can often produce significant savings in buildings with large, complex, intermittent loads. Such a system can be used to control several areas such as those with different heating, ventilating, and air conditioning requirements, supplying only what is needed by each area. Other features include night set-back for chillers and areas that do not operate on a 24-hour basis, night flush to use outside air to cool areas with excessive daytime heat gains, load scheduling to avoid electrical demand charges, and a 365-day time clock to control interior and exterior lighting and operate seasonal equipment.

ENERGY ACCOUNTING WORKSHOPS

Do you want to sharpen your energy management skills?

These **free**, one-day sessions will teach participants how to organize their building's energy bills, graph and analyze energy consumption, and establish realistic energy management goals for their facility. Topics to be covered include rate schedules, demand charges, and computer accounting software.

Workshop attendees are requested to **bring 12 months of energy bills, a calculator, and a computation of the total heated area for their building**. During the workshop, DNRC staff will help participants set up their facility's personalized energy file.

Building managers and plant operators won't want to miss these hands-on workshops. Institution administrators and school superintendents also are encouraged to attend.

TIME: All workshops run from 8:30 A.M. to 4:30 P.M.

PLACE:	**DATE**:
Cut Bank Glacier Electric Co-op Meeting Room 410 East Main	Tuesday, April 11
Kalispell Flathead Electric Co-op Meeting Room 2510 Highway 2 East	Wednesday, April 12
Missoula Quality Inn V.I.P. Room 1609 West Broadway	Thursday, April 13
Butte Copper King Inn Copper King Parlor 4655 Harrison Avenue	Friday, April 14

Energy Division, DNRC
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1520 East Sixth Avenue
Helena, MT 59620-2301

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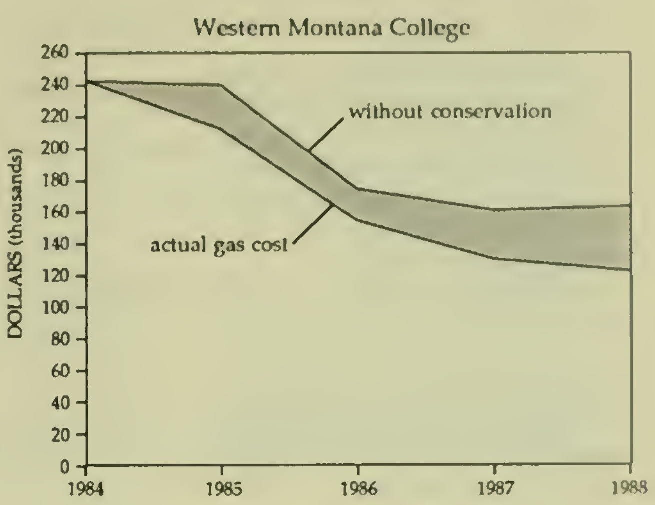
Return form to: DNRC, Energy Division; 1520 East Sixth Ave.; Helena, MT 59620-2301

Workshops (continued)

During April, DNRC will sponsor a series of Energy Accounting Workshops. The workshops will be conducted in Cut Bank, Kalispell, Missoula, and Butte, and will be funded by the Bonneville Power Administration.

Administrators and school superintendents, as well as building managers, maintenance personnel, and plant operators are invited to attend the one-day sessions. These workshops will teach participants how to organize and evaluate the energy data and consumption patterns of their buildings. Armed with this understanding, managers and operators will then be better able to identify and prioritize their energy management activities.

The shaded area in this graph (corrected for annual weather differences and reductions in natural gas costs) shows the avoided costs each year due to conservation efforts. Generating graphs such as this will be covered in our upcoming Energy Accounting Workshop.



The Energy Accounting Workshops will be led by Bill Younger and Neil Marsh of DNRC's Energy Division. Bill Younger provides technical assistance on energy problems to administrators and operators of Montana schools, hospitals, and commercial and public buildings. Younger has taught several energy management seminars throughout Montana, Oklahoma, and at the World Energy Engineering Congress held last October in Atlanta, Georgia.

Neil Marsh has an environmental engineering degree from Stanford University and has taken graduate coursework in mechanical engineering at Oregon State University. For the past three years, he's worked for DNRC trouble-shooting problems with heating and ventilation systems and conducting workshops about energy-efficient construction.

Workshop participants are requested to bring the utility bills from the previous 12 months for their buildings and a calculator. Also, please compute the total heated area of your building (in square feet) and provide that figure to the workshop leaders. This information will be used during the workshop to set up an energy accounting file for your building.

See the insert included in this issue for the dates, times, and locations of these free workshops. To preregister, please call Jody Nugent at 444-6697.

Technical Tips

Electrical Equipment: General Operations and Maintenance

Electrical equipment should be checked and repaired regularly. Equipment not operating properly consumes unnecessary energy. Thus, it is less efficient and more prone to break down. You'll need to use lubricating oil as specified by the manufacturer of the equipment.

For any piece of belt-driven equipment, set the amount of belt slack recommended by the equipment manufacturer. Check the operating manual or ask your supervisor to find out how much slack should exist. If the belt is too tight, energy is wasted because there is too much friction, and bearings wear out faster. If the belt is too loose, slippage will reduce the equipment's capacity and will cause the equipment to operate inefficiently.

Keep motors free of anything that blocks cooling. A cooler motor operates more efficiently.

Lubricate motors following the manufacturer's specifications. Lubricating motors on schedule and according to directions will prolong motor life, reduce friction, and reduce the amount of energy consumed for the work done. Do not over lubricate. Too much lubrication can clog moving parts, collect dirt, and decrease operating efficiency.

Employees (continued)

First, they recommended consolidation, which allowed the closure of several buildings and the top two floors of another building. People were persuaded to move from the inefficient staff houses into more energy-efficient houses.

Then employees were encouraged to get involved in the effort. The committee developed checklists on how to save energy, and set aside one month as "Hospital Energy Conservation Month."

"We tried to gear the program so there was something in it for them, not just something for the hospital. We tried to show them how to stretch their pay check by saving energy at home as well as at work," McCarthy said.

The committee also ran a contest to find the three best employee suggestions for saving energy at the hospital. The top ideas included installing fiberglass batts to insulate the suspended ceilings, replacing incandescent lights in the solarium with fluorescent ones, and using photoelectric cells to prevent outside lights from being left on during daylight hours.

The committee also drew on the expertise and experience of energy experts outside the institution. Invitations and requests for participation in a walk-through audit were sent to various federal, state, and private agencies. Local newspaper and television reporters were invited along on the walk-through audit.

The experts' tour pinpointed many low- and no-cost ideas that could be easily implemented. Discovering that the building was too warm in some rooms and too cold in others, the energy experts recommended installing more thermostats and heat controls. The auditors also saw that behind curtains and shades some double hung windows had slipped open without being noticed. They suggested closing and caulking the windows.

Several energy-saving measures have been implemented, including:

- Street light conversion from 300-watt incandescent to 150-watt high pressure sodium.
- An air curtain over the food delivery door.
- A new power burner for the boiler.
- Window repairs.
- Removal of deteriorated insulation and reinsulation of boiler steam lines.
- Preventative maintenance program for steam traps.

Although the exact energy savings generated are difficult to measure, the hospital has shown a decline in both the amount and the cost of utilities since the inception of the Energy Committee in August 1983. In 1986, the Montana State Hospital won a National Award for Energy Innovation. The award cited the energy conservation program for reducing the hospital's operating costs between 1982 and 1986 by about a quarter million dollars a year. DNRC's records show that for each year during fiscal years 1984 - 1987, the hospital consumed 23 to 30 percent less natural gas than in 1982 (weather-corrected), before the conservation measures were initiated.

In 1988, DNRC contracted with a private engineering firm to conduct a comprehensive energy analysis of the Warm Springs and Galen campuses. While the employee-oriented program has proved successful, the study has identified several cost-effective capital improvements that would help the hospital achieve substantial additional energy savings. These improvements are being proposed to the 1989 Legislature as part of a bond-funded energy retrofit program. Bonds would be issued to cover the cost of retrofits on eligible state buildings, such as the Montana State Hospital. The program is designed so the energy savings realized would equal or exceed the debt service on the bonds.

This article was adapted from "Energy Savings—Hospitals" (DNRC 1986)

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For Commercial and Institutional Building Operators

December 1988

Inside...

Welcome to Energy Source, a periodic bulletin for institutional and commercial building operators. This third edition highlights:

- DNRC's Boiler Efficiency Workshops being held in January
- the success of the Bozeman School District
- facts on the Institutional Conservation Program
- tips for lighting savings
- Energy Smart Design and Montana Commercial Structures Programs
- other upcoming events

We invite you to comment on the usefulness of this publication and encourage you to suggest topics or provide materials for future editions. Multiple copies are available on request. Please address your correspondence to:

Peggy Nelson
Montana Department of Natural
Resources and Conservation
1520 East Sixth Avenue
Helena, MT 59620-2301
444-6697

Thanks go to the **Bonneville Power Administration** for providing funding for this bulletin.

Don't forget about DNRC'S inventory of energy conservation training videocassettes available free from our lending library.

Bozeman Schools Cut Utility Bills by 60 Percent

Gary Griffith recently achieved a goal he set for himself five years ago. And in the process, he cut the Bozeman school system's natural gas bills from $309,000 to $123,000 a year.

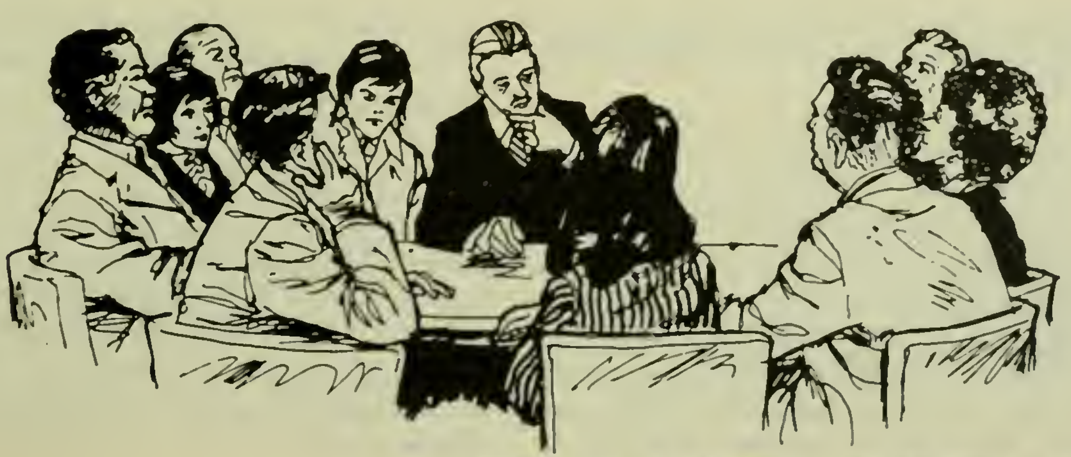
Just before Griffith was hired to head the school system's maintenance department in 1982, an engineering firm went through each of the district's eight buildings, identifying ways to save energy. The reports were on Griffith's desk his first day on the job. Griffith read the reports and set a goal of cutting the school district's energy use by 45 percent. He zeroed in on several of the firm's suggestions for saving energy. "I tried to go after the biggest paybacks first," he said. "It's like taking the frosting off the cake."

The first year, Griffith added roof insulation, removed the skylights, and insulated the hot water tank at Emerson School. He also put an optimum stop-start system on the Whittier School boiler. The projects cost a total of $81,025.

Griffith received a $40,512 **Institutional Conservation Program** (ICP) grant to help cover the costs. Funded by the U.S. Department of Energy, the program is administered by DNRC. (See page 2 for related article on ICP.) ICP grants cover half the cost of installing energy conservation measures on schools and hospitals. "That's what got us started." Griffith said.

The first project was so successful that the school system went on to install 70 to 80 energy conservation measures in the schools over the

(Continued on page 3)



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BULLETIN BOARD

Upcoming Free Workshops

Water treatment and troubleshooting will be the focus of this year's boiler efficiency workshops. DNRC will sponsor the intensive, two-day seminars in Billings, Butte, Great Falls, Miles City, and Missoula during January 1989. These free workshops are a **do not miss**, even for those boiler operators who attended last year's workshops. Funded by the Department of Energy, these workshops will show you:

- Over 45 ways to improve plant performance
- How to select options for maximum efficiency
- Applications of state-of-the-art equipment
- How to "measure and manage" energy costs
- How to use computer power to cut costs
- How to "tune up" a plant

Workshop instructors are **Harry Taplin**, P.E. and **Delmer Sneed**, P.E. of BTU Consultants. Mr Taplin has more than 25 years experience in boiler operations, design, testing, and troubleshooting. He has conducted workshops for the Association of Energy Engineers for the past ten years. Mr. Sneed has had 15 years experience working on boilers, steam traps, and distribution systems. Since 1982, he has been a community college instructor, lecturing on heating and cooling systems. For workshop dates and locations, see insert.

In April of 1989, DNRC will present several energy management workshops across the state. Look for the specifics of these workshops in the next issue of *Energy Source*.

Current ICP Grant Cycle Closes

The application deadline for the current funding cycle of the Institutional Conservation Program (ICP) closed on December 1st, 1988. A total of 16 eligible schools and hospitals entered the competition for energy study and retrofit funding. Applications are currently being reviewed by DNRC. DNRC will make funding recommendations to the U.S. Department of Energy (DOE) early in 1989, and DOE will make final grant awards. Thirteen school districts, 1 hospital, and 1 state university (with two requests) have requested $587,709 in grant funds. Those successful applicants who are not eligible for hardship funding will match dollar for dollar the funds they receive. Grants to institutions that qualify for hardship funding cover a larger portion of the project costs.

In the previous funding cycle, 30 school districts, 3 hospitals, and 2 colleges across the state received about $1.1 million in ICP grants — including about $200,000 in federally appropriated DOE funds and $900,000 in state appropriated Petroleum Violation Escrow (PVE) account funds (see cover story). The PVE account was established to provide restitution to the public for overcharges made by oil companies before the oil industry was deregulated.

During the current funding cycle, DOE will again provide approximately $200,000 in matching funds. DNRC will use interest accrued on PVE funds to fund some of the grant requests received this year. More PVE funds will be requested during the upcoming legislative session.

Design Assistance for New Commercial Buildings

To encourage energy-efficient design in new commercial buildings in western Montana, the Bonneville Power Administration and eight electric cooperatives offer free services under the Energy Smart Design Program. The participating electric cooperatives are located in Corvallis, Eureka, Cut Bank, Missoula, Troy, Polson, Dillon, and Kalispell. These utilities provide consultations, supply information, and offer recommendations about electrical lighting and heating to commercial building designers, builders, and developers. The program provides recognition to building owners and designers whose new structures meet certain prescribed levels of energy efficiency.

The Montana Power Company offers a similar program for commercial building owners and designers within their utility service area. Called the Montana Commercial Structures Program, this project takes a different approach for providing recognition to participating building design professionals. Awards are given for new commercial structures that achieve optimum, cost-effective levels of energy efficiency.

For more information, contact one of the electric cooperatives mentioned above or the local Montana Power Company office.

BOILER EFFICIENCY WORKSHOPS

These **free**, comprehensive, two-day sessions will include a focus on water treatment and troubleshooting. They are a different series than the boiler workshops conducted last year. You won't want to miss this opportunity.

Harry Taplin, P.E., and Delmer Sneed, P.E., of BTU Consultants are the workshop presenters. They have over 40 years of combined experience in boiler operation, design, testing, and troubleshooting.

TIME: All workshops run from 8 A.M. to 5 P.M. on **both** days.

PLACE:	**DATE**:
Great Falls Vocational Technical Center 2100 16th Avenue South	Monday - Tuesday, January 16 - 17
Missoula University of Montana Montana Room University Center	Wednesday - Thursday, January 18 - 19
Butte Montana Tech Campus Student Union Building	Friday - Saturday, January 20 - 21
Billings Eastern Montana College Lewis and Clark Room Student Union Building	Monday - Tuesday, January 23 - 24
Miles City Miles City Community College Room 106	Wednesday - Thursday, January 25 - 26

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Helena, MT 59620-2301

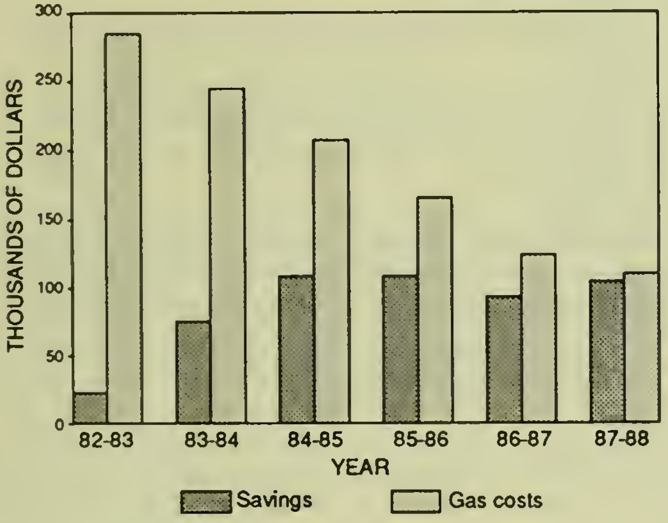
There is no charge for attendance. However, we would like to know if you plan to attend. Call Jody Nugent at 444-6697 to register. If there is insufficient pre-registration, these sessions could be cancelled.

Bozeman Schools (continued)

past four years. ICP provided a total of $362,877 to help pay for the energy conservation measures. They modified the heating and ventilating systems and added roof and wall insulation at several schools.

"One of the first things we did was to cover parts of some windows with insulated panels," Griffith said. "You could make a small snowball from the amount of snow that blew in around the windows in some classrooms," he said. "We blocked the windows for comfort as well as energy savings. We now have a better teaching environment in those classrooms."

BOZEMAN SCHOOLS NATURAL GAS COSTS & SAVINGS
1982-1987 TOTALS FOR ALL FACILITIES



Griffith attributed the continuing success of the energy saving program to the people who operate the buildings. "The eight head custodians sit around a table in my office each month, and we review the energy use of each building," he said. "There's a subtle competitiveness. No one likes to see his building the worst energy user every month." (see inset below)

If a building's energy use suddenly goes up, Griffith added, the head custodian immediately sets out to find the problem. "It could be a time clock that's off or a steam trap that's open," he said. "They find and fix the problem. And next month the energy use is back down where they want it."

Several very effective techniques for cutting energy costs have come out of the monthly energy reviews, Griffith noted.

"Arnie De Hann, head custodian at Willson School, suggested a pressure control override for the boiler," he said. "The override keeps the boiler from coming on too often at night and on weekends. The whole idea is to keep the burner off when we don't need it; running the burner makes the gas meter go around. Installing the override cost $350. But it saved ten times that in the first year."

During 1988, The Bozeman School District was awarded $37,760 in ICP grant funds to help pay for energy conservation measures at the high school. The Bozeman High School project will include installing infrared sensors in classrooms, shops, and bathrooms that will turn off unit ventilators when the rooms aren't being used. Griffith said he also plans to install a computerized energy management system (EMS) at the high school.

"The EMS will put the whole building at the custodian's finger tips," he said. "He'll know the exact times the boiler comes on and the number of cycles it goes through. It's like reading the heartbeat of the boiler. He knows how many times the boiler should cycle. Then if that starts to change, we can go looking for what's wrong. The EMS calls our attention to problems sooner and allows us to fix them before they become expensive, major problems."

After this year's projects are completed, Griffith said the school system will have performed most of the cost-effective conservation measures it can to save natural gas. Now he's concentrating on saving electricity.

"I think we've taken a real good shot at cutting down our energy bills," Griffith said. "But you're never done, especially when electricity prices keep going up."

—by Pat Hoban, DNRC

Montana State Government...
Watch for the details on our peer matching program. Based on the success in Bozeman, DNRC will set up several meetings where professionals with energy management responsibilities for state institutions can come together and exchange energy conservation information. In the next seven months, two or three 90-minute to 3-hour sessions will be held in different Montana communities. The facilitators for the sessions will be building managers who have a success story to bring to their peers regarding energy saving strategies.

Tips for Cutting Lighting Costs In Your Building

Reducing the waste of lighting energy is the key to lower electric bills.

1. Energy is lost through overlighting. To lessen these losses:

- Remove unnecessary lamps where lighting is too bright, such as in areas near windows and in hallways.
- Turn off lights when an area is unoccupied.
- Reschedule evening cleaning, reduce or eliminate other evening activities.
- Use partial lighting before and after "public" hours.
- Install desk lamps and other types of "task lights" at work areas such as office desks, drafting tables, and product assembly areas.
- Reduce or eliminate unnecessary outside lighting.
- Use only necessary levels of safety and security lighting; consider installing motion sensors on security lighting.
- Whenever possible, install timer switches that automatically turn lights on and off. If timers are already in use, make sure they are working and set properly.
- Install dimmer switches.

2. Lighting energy is wasted through transmission losses. To minimize these losses:

- Clean lamps and fixtures annually. Dirty fixtures can reduce light output by 20 percent.
- In areas where fluorescent lamps have been removed and are no longer used, check to ensure the ballasts are disconnected.
- Replace yellowed or hazy lenses, diffusers, and globes with new ones that are not yellowed by ultraviolet light.

3. Lighting energy is wasted through inefficient sources. To reduce these losses:

- Install high-efficiency fluorescent lamps to replace incandescent ones.
- Install more efficient ballasts when replacing burned out ones.
- Relamp with lower wattage incandescent lamps.
- Replace two lower-wattage lamps with one higher-wattage one.
- In many cases, fluorescent lamps with incandescent-type screw-in bases are available. When possible, replace individual incandescents with fluorescents.

From DNRC's free publication, "How To Reduce Energy Costs In Your Building"

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For Commercial and Institutional Building Operators

Fall 1988

About this bulletin ...

Welcome to *Energy Source*, a periodic bulletin for institutional and commercial building operators. This publication provides practical information to the operators of commercial-scale buildings.

Energy Source will provide ...

- articles to help you improve your building's energy performance
- current listings of the energy conservation training videos available **free** from our lending library
- announcements of upcoming energy conservation and building maintenance workshops.

We welcome your comments on the usefulness of this bulletin. We also encourage you to suggest topics or provide material for future editions. Address your correspondence to **Peggy Nelson** at the address below.

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Funding for this bulletin is provided by the **U.S. Department of Energy**. We ask that you correct any address errors by returning the mailing label to DNRC with the changes noted. Persons or organizations who wish to be added or removed from the mailing list may do so by notifying this office.

If you receive extra copies of this bulletin, please pass them on. We are updating our mailing list to eliminate duplication.

Workshops set for eastern Montana

DNRC workshop reaps savings for St. Luke's

In June, DNRC sponsored a series of half-day workshops in western Montana for building operators. Instructor David Seaberg conducted eight sessions on **Heating, Ventilating, and Air Conditioning**. In a separate session, Seaberg performed a brief, hands-on technical analysis of the mechanical system at St. Luke Community Hospital and Nursing Home in Ronan.

For several years, the building's cooling system hadn't performed properly, and staff complained that the building wasn't cool enough during summer. During his visit, Seaberg located and repaired the recurring control problem in a 20-ton chiller unit. At the same time, he suggested several other operation and maintenance activities that would increase the building's efficiency. St. Luke Administrator, Larry Robinson remarked, “As a result of the one-on-one assistance, we noticed an immediate change in improved comfort.”

Once again, the DNRC Energy Division is sponsoring a series of half-day maintenance workshops. Scheduled for September and October, the workshops will take place in eastern Montana communities and will be funded by the Department of Energy.

In separate sessions, the workshops will cover the following topics:

- **Heating, Ventilating & Air Conditioning (HVAC)**
- **HVAC Controls: Maintenance & Calibration**
- **Lighting Technology & Maintenance**
- **Electric Motors & Pumps**

David Seaberg of Northeast Metro Technical Institute will lead the HVAC and HVAC Controls workshops.

John Krigger, owner of Saturn Resource Management, will lead the Lighting Technology & Maintenance workshops.

Larry Olson, president of Mechanical Technology, Inc. will lead the Electric Motors & Pumps workshops.

An insert to this issue shows the schedule of dates, times and locations for these workshops. For further information, call Jody Nugent at 444-6697. The workshops are free.

PLEASE RETURN

Tracking down energy savings

You can cut your electricity and natural gas costs by eight to sixteen percent just by keeping track of your energy use, according to Marvin Gough, former director of the American Hospital Association's Energy Task Force.

"If your utility company said they'd give you one or two months' free energy if you would just track your energy comsumption, would you do it?" Gough asked the 45 people attending the Montana Health Care Association Convention in Helena in April 1987. "I guarantee you will get those kinds of savings if you just start tracking your energy consumption."

Before his talk in Helena, Gough studied two nursing homes in southwestern Montana. One, a 57-bed facility, spent $20,201 on natural gas and electricity in the year ending February 28, 1987, and $24,051 in the preceding year. The second, a 98-bed skilled-care facility, spent $28,775 in the year ending November 30, 1986.

"Saving eight to sixteen percent on those bills could quickly add up," he said.

"Energy is a non-emotional, non-controversial economy measure," Gough said, adding that you can save money on energy without decreasing the quality of patient care or decreasing patient comfort in any way. "And the savings go on year after year in many cases."

No Cost - Low Cost Savings

You can also make substantial cuts in energy costs without capital expenditures or with minimal expenditures.

Gough recommended that nursing homes start

(continued on page 4)

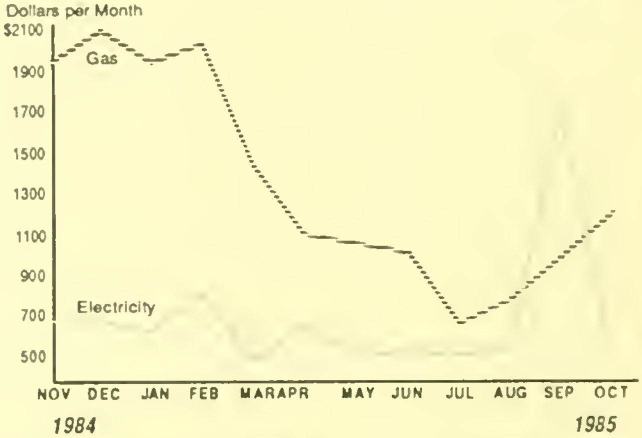

Figure 1. Energy Costs per Month *This graphs tracks the gas and electricity costs for a southwestern Montana nursing home.*

Energy videotapes available for loan

The Energy Division offers videotapes designed for owners and operators of commercial and institutional buildings. These videotapes cover various aspects of energy management and operating procedures.

DNRC will loan the tapes to you, **free of charge**, one or two at a time. They must be returned to DNRC within two weeks. DNRC will pay the cost to ship them to your organization, but we request that you pay the return postage.

The name and address of the distributor is on each tape, should you wish to purchase copies for your own use.

All videotapes are 1/2 inch VHS format. An order form is provided on page 3.

From Oregon State University

001. Safe and Efficient Boiler Operations
    - 36 minutes, with handbook

002. Irrigation Energy Conservation: System Efficiency
    - 37 minutes

003. Irrigation Energy Conservation: Management Efficiency.
    - 37 minutes

From E.T. Harlow Co.

004. Unit Ventilator Reconditioning
    - 22 minutes

005. Boiler Maintenance, Operation, and Safety
    - 30 minutes, with handbook

006. ECONOMIZER Testing and Tune-Up
    - 30 minutes

007. Hot Water Reset For Hydronic Heating System
    - 17 minutes, with handbook

008. Multizone Hot Deck Controls
    - 14 minutes, with handbook

Armstrong MachineWorkshop

009. Guidelines for Steam Trap Troubleshooting
    - 19 minutes

010. Solving the Water Hammer Puzzle
    - 24 minutes

011. Guidelines For Steam System Efficiency
    - 15 minutes

See order form on page 3.

Lighting, Motors, and Pumps Workshops

date	place	time	topic
September 19, 1988	**Helena**	8:30–12:00	Lighting Technology & Maintenance
Montana State Highway Dept. *Building Auditorium* *2701 Prospect Avenue*		1:00–4:30	Electric Motors & Pumps
September 20, 1988	**Great Falls**	8:30–12:00	Lighting Technology & Maintenance
Paris Gibson Junior High *Room #209* *2400 Central Avenue*		1:00–4:30	Electric Motors & Pumps
September 21, 1988	**Billings**	8:30–12:00	Lighting Technology & Maintenance
Eastern Montana College *Student Union Building* *Lewis Room*		1:00–4:30	Electric Motors & Pumps
September 22, 1988	**Miles City**	8:30–12:00	Lighting Technology & Maintenance *ONLY*
Miles Community College *Room 316* *2715 Dickinson*			

HVAC Workshops

date	place	time	topic
October 3, 1988	**Great Falls**	8:30–12:00	HVAC Maintenance
Sheraton Hotel *Russell Room* *400 10th Avenue South*		1:00–4:30	Control Maintenance & Calibration
October 4, 1988	**Helena**	8:30–12:00	HVAC Maintenance
Lee Metcalf Building *DNRC Conference Room* *Main Floor* *1520 East 6th Avenue*		1:00–4:30	Control Maintenance & Calibration
October 6, 1988	**Billings**	8:30–12:00	HVAC Maintenance
Holiday Inn *Billings Plaza* *I-90 & Mullowney* *Gallatin Room*		1:00–4:30	Control Maintenance & Calibration

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Helena, Montana 59620

No charge for attendance. However, we would like to know if you plan to attend. Call Jody Nugent at 444-6697 to register.

NOTE: If there is insufficient pre-registration, these classes could be cancelled

Technical Tips: Inspect steam traps as preventative maintenance

What: Observe and test steam traps for leaks.
Why: One leaking steam trap can cause $1,000+ worth of steam to escape in a year.
Tools: 1. Mechanic's stethoscope with an extension lead.
2. Contact pyrometer with both a flat and a needle probe.
3. One pair of heavy gloves.
4. Steel brush.

Steps:

1. Observe and report: Most steam systems have vented condensate tanks to release pressure and allow gases which won't turn into liquid to escape. If steam traps are leaking, the steam will escape from the vent pipes.

Look at the vent pipes from all condensate tanks each day. A plume of steam from the vent pipe does not necessarily mean that a steam trap is leaking. As condensate passes from the high pressure on one side of the trap to the low pressure on the other side, some of the condensate will flash to steam. "Flash steam" is saturated steam. Steam from leaking traps is superheated steam.

You are looking for superheated steam. Superheated steam will have a plume which is clear at the base. It becomes white only after it gets up into the air. Picking out the right plume takes practice. But it is very important. Remember the plume will change a little as the steam load varies. It will also vary with wind speed, temperature, and humidity changes.

2. Look at the trap, connecting pipes, and valves. Check for corrosion.

3. Once you know that somewhere in the system a trap is leaking, try to find it. Many traps feed the same tank. Finding the leaking one takes time.

a. Look for the "hot" line. Measure the temperature of the lines leading to the tank. Use a surface contact thermometer to do this. Clean the pipe surface by the trap with a wire brush. Place the flat contact probe of the pyrometer on the pipe surface. Keep it there until the needle stays still. Record the temperature.

A cool line, below 200 degrees F., means no trap is leaking above it. A hot line, above 200 degrees F., is not proof a trap is leaking. But you have narrowed down the possibilities.

b. Hot lines can sometimes be spotted by valving off return lines one by one and looking at the plume. Ask your supervisor if the lines have valves and if you can use this procedure. Do not turn valves without checking first.

c. Measure temperatures of return lines from equipment which is not being used. A hot line is a good sign of a faulty trap.

4. Check traps you think may be faulty. You can do this in two ways: use infrared thermography, if available, or use a mechanic's stethoscope and listen to the trap as it operates. Each trap type has its own sounds (see box); place the probe in several areas and record the sounds you hear. Also listen to the pipe. You may be getting an echo from somewhere else.

Make three separate tests: 1) with steam on and flowing; 2) with it totally off (using valves); and 3) on a bypass leg where installed. Record these sounds.

5. Report findings to your supervisor.

(This article reprinted with permission from Washington State Energy Office)

Steam Trap Operating Sounds

Disc Thermodynamic Trap (pressure)
operating properly
Opening and snap-closing of disc several times per minute.
failure
Rapid chattering as steam passes through.

Mechanical (bucket float)
operating properly
Cycling sound of bucket as it opens and closes.
failure
Whistling sound of high-velocity steam.

Thermostatic
operating properly
Sound of periodic discharge if medium to high load; possibly no sound if light load; throttled discharge.
failure
Fails closed; no sound.

VIDEO ORDER FORM

Name: ____________________

Organization: ____________________

____

Address: ____________________

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City, State, Zip: ____________________

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Work Phone: ____________________

Please send me the following videotape(s):

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Tracking energy savings (cont'd)

their energy conservation programs by taking the no-cost and low-cost measures first.

Take a Positive Cash Flow Approach

"Take a positive cash flow approach to undertaking energy conservation measures," he said. "Implement the no-cost measures first, track the savings, and apply the savings toward cost-effective measures that require a capital outlay."

Gough urged nursing home administrators to carefully go over their gas and electricity bills each month. "Then look at your gas and electricity bills for the past year — or even better, for the past three years — to see the month by month changes," he said. If you don't have the utility bills in your files, he added, ask you local utility for that information. Putting the information on energy consumption and costs into graphs is very helpful (see figure 1).

To factor out the severity of the weather, you can make graphs based on the amount of energy used per degree day. Most utilities keep track of the degree days in their area.

What to Look for

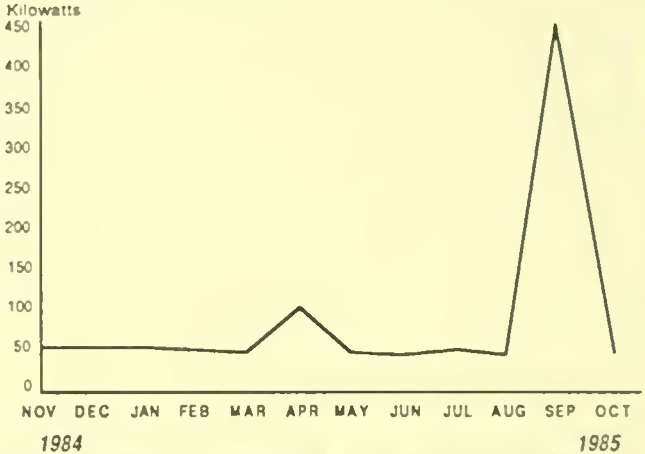
A very important step, Gough added, is making sure your nursing home is on the right rate schedule.

"Contact the customer service representative at your local utility and ask about your rate schedule," he said. "And ask them to explain exactly how the rate works. Some utilities add peak demand charges, charging a premium for the highest amount of electricity you use in any 15-minute period during the billing period. You can, for example, make substantial cuts in your demand charges by staggering the start-up times for equipment that uses a lot of electricity."

Cost Per Bed

He also urged the administrators to look at their utility bills in several different ways.

"In addition to adding up just how much you're spending per year for electricity and natural gas," he said, "take a look at how much that calculates out to per square foot of building space or per bed per year."



Electric Demand. *The September spike in demand cost a southwestern Montana nursing home $1100. Since the spike is exactly 10 times the usual demand, it may be due to a meter reading error or the result of other problems or practices.*

One of the Montana nursing homes Gough studied was spending $354.62 per bed per year for gas and electricity; the other was spending $293.62.

"Compare your performance this year to last year's," he said. "But don't try to compare your performance to that of another nursing home. Each building is different. What you're looking for is reduction in **your** energy consumption."

Gough urged administrators to work closely with their maintenance supervisors on energy conservation and to share the energy cost tracking information with them. "This will let your maintenance supervisor know how important his contribution is to the success of your nursing home."

The tracking will lead you to the money-saving measures that will work the best for your facility, he said. Each facility is different, and knowing your facility — knowing what will work for you and what won't work — is the key to saving energy and money.

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Energy Source

For Commercial and Institutional Building Operators

December 1989

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Inside ...

The Department of Natural Resources and Conservation produces and distributes *Energy Source*. This periodic bulletin provides practical information to managers and operators of commercial-scale buildings. This issue looks at:

- Missoula hospital energy activities
- Institutional Conservation Program
- Boiler checklist
- O&M manuals
- Regional training
- DNRC's video library

Thanks go to the U.S. Department of Energy who sponsored this edition.

We welcome our readers' comments. Send them to:

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Department of Natural Resources and Conservation
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Helena, MT 59620
444-6697

Maintenance Director Makes a Difference

Missoula Hospital Cuts Energy Use

The first thing Gary Palmer did when he became director of support services at Community Medical Center in Missoula three and a half years ago was to set up a preventive maintenance program.

"I personally did a complete inventory of the equipment and put it on a computerized preventive maintenance program," Palmer said. "We track it monthly to see how we're doing, and we're making improvements all the time. The plant operations staff has worked very hard to make this program work." Palmer uses the Service Master program in a Texas Instruments Business Pro computer. "Making sure you're maintaining all your equipment," he said, "is a great way to start an energy conservation program."

Since energy costs account for 48.5 percent of the hospital's plant operations budget, Palmer said he is always looking for ways to reduce operating costs by saving energy.

And his efforts have paid off handsomely. Although the hospital has added 20,000 square feet to its building and installed many new electrically run machines, both mechanical and clinical, in the past two years, Palmer said that overall energy consumption at Community has stayed about the same. But, he added, its Btu use per square foot dropped from 353,127 in 1985 to 298,414 in 1988.

Palmer attributed much of the savings to a series of low-cost energy-saving measures they've used at the hospital. In addition to the preventive maintenance program, Palmer recommended the following measures.

1. Record keeping. Regular, understandable reports on energy use will help you: evaluate existing energy use and set goals; spot overcharging; identify and correct mechanical problems; identify areas with the highest potential for energy savings; and track how successful your energy conservation measures are.

2. Enlisting the active support and involvement of the administration. This provides the resources you

(continued on page 2)

Troubleshooting Tape Available

DNRC has available a training video on Troubleshooting Techniques for free viewing through its videotape library. The Troubleshooting series is produced by TPC Training Systems of Chicago, Illinois. DNRC has recorded the series' seven 15-minute segments onto one tape. The segments are:

- Planned Maintenance
- Working With Other People
- Preparing for Troubleshooting
- Using Schematics & Diagrams
- Solving Mechanical Problems
- Solving Electrical Problems
- Breakdown Maintenance

Building operators and managers are encouraged to view this tape. See the insert in this issue on DNRC's commercial energy videotape library for ordering information.

PLEASE RETURN

(Hospital, continued)

need for an energy conservation program and helps motivate all staff members to help save energy. Studies by the U.S. Department of Energy show that active involvement at the top of an organization routinely doubles the savings achieved in hospital energy management programs.

3. Conducting a thorough evaluation of your building's energy usage. Community Medical Center had an engineering firm do a technical assistance audit under the Institutional Conservation Program (see related article). Based on the audit, the hospital developed an energy conservation plan listing the possible energy conservation measures and identifying those with the best payback. The plan showing the costs and projected savings made it easier to sell the facility administration on the energy conservation program.

4. Targeting the largest energy uses first. In a typical hospital, HVAC uses 40 to 60 percent of all energy consumed. The laundry is the second largest energy user; lighting is third; and food service is fourth. These are good places to look for ways to save energy because your efforts will have the most impact.

5. Establishing an education and training program. People at all levels of facility operations need training on energy conservation. In addition to technical training for the maintenance staff, you need to provide education for the administration and all building occupants on how they can help save energy. And it's important to keep everyone informed on how well you're doing.

ICP— A good Investment Option

The Institutional Conservation Program (ICP) is a federal program that provides 50 percent matching funds for the preparation of technical engineering studies and the implementation of energy conservation measures in schools and hospitals built before 1977. Funded by the U.S Department of Energy (DOE), ICP is administered in Montana by the Department of Natural Resources and Conservation (DNRC). Since 1978, more than 160 Montana institutions have been awarded over $6.6 million in ICP grants for the installation of energy-saving improvements.

In 1988, DNRC conducted a statistical analysis of ICP. DNRC extensively evaluated the energy-saving improvements installed in 24 gas-heated Montana schools between 1981 and 1985. This analysis revealed that the schools had an average annual reduction in natural gas consumption of 28 percent. Further, the savings from reduced heating costs more than paid for the conservation measures that were installed.

Findings showed that the selected conservation measures were typically cost-effective compared to other conventional investment opportunities. The statistics also confirmed that, in general, the technical reports prepared for ICP are good decision-making tools for both institutions and funding agencies.

As part of the analysis, DNRC calculated the expense of each conservation measure installed in the schools. The average cost of each modification was $36,700. The simple payback for each modification ranged from 2 years to 10 years.

DNRC also used the net present value approach to assess the value of each energy-saving project implemented in the 24 schools. The net present value approach compares the return received for installing a conservation measure to the return received for investing funds in an interest-bearing account. If a conservation measure has a positive net present value, the energy savings over the life of the measure are enough to repay the cost of the measure plus interest that would have been earned on that amount.

ICP Manager, Bill Younger, works on net present value calculations

DNRC determined that, in most cases, the schools would earn more by investing in the energy-saving measures than by leaving the funds in the bank to earn interest. The average net present value of the modifications was $34,600 per school. This means the average school will earn $34,600 more through the useful life of the project by installing the energy-saving measures than would be earned by investing in conventional financial options during the same period. The 24 schools in DNRC's study will realize a combined net economic benefit of $829,700.

For more information about ICP, contact DNRC's Energy Division at 444-6697. Copies of the ICP analysis, "Evaluation of Energy Conservation Measures in Montana Public Schools," are also available upon request.

Free Training On Videocassettes Available

DNRC's Energy Division offers videotapes designed for owners and operators of commercial and institutional buildings. The tapes cover many aspects of energy management and operating procedures.

DNRC will loan the tapes to you, free of charge, one or two at a time. They must be returned within two weeks. DNRC will pay the cost to ship them to you, but you must pay the return postage. All videotapes are 1/2 inch VHS format.

An order form is provided. Indicate which tape(s) you wish to view and the date you want them. Please use the number that appears directly before the title.

From Oregon State University
001 **Safe and Efficient Boiler Operations**, 1987, 36 minutes, with handbook. Shows how to save money on fuel, repairs, and other operating costs for small boilers.

From E.T. Harlow Co.
002 **Unit Ventilator Reconditioning**, 22 minutes. Looks at operation and maintenance of unit ventilators with face and by-pass dampers. Covers cleaning, re-gasketing damper blades, and adjusting damper linkages.

003 **Boiler Maintenance, Operation, and Safety**, 30 minutes, with handbook. Covers operating characteristics and safety controls for atmospheric and power burner boilers.

004 **Economizer Testing and Tune-up**, 30 minutes. Demonstrates methods for adjusting make-up and return air dampers in a HVAC system.

005 **Hot Water Reset For Hydronic Heating System**, 17 minutes, with handbook. Describes a hot-water system, water reset control, and three-way mixing valve. Techniques for checking set points and proper operation of the reset control are demonstrated.

006 **Multizone Hot Deck Controls**, 17 minutes, with handbook. Describes components of multizone air handling system, including resetting the hot deck temperature based on outside temperature.

From Armstrong Machine Workshop
007 **Guidelines for Steam Trap Troubleshooting**, 19 minutes. Outlines how to establish a preventative maintenance program, emphasizing testing of various traps.

008 **Solving the Water Hammer Puzzle**, 24 minutes. Discusses causes and effects of water hammer on a steam system, and prevention strategies.

010 **Let's Talk Steamtraps/Update**, 1984, 32 minutes. Discusses operation of steam traps, focusing on inverted bucket, thermostatic, disc, and differential condensate controllers.

011 **The Anatomy of the I.B.**, 15 minutes. Uses a glass model to look at the performance and components of inverted bucket steam traps.

012 **Guidelines for Steam Trap Repair**, 1988, 20 minutes. Outlines different types of steam traps, gives techniques for repairing each, and shows how to spot faulty ones.

013 **Guidelines for Steam/Air Coil System Design**, 1988, 13 minutes. Explains causes of frozen steam coils and the steps to take to prevent problems.

From Illuminating Engineering Society
014 **Lamps and Luminaires**, 1982, 20 minutes. Talks about energy saving lamps, including high intensity discharge, and warm and cool renditions.

From TPC Training Systems
*015 **Developing Troubleshooting Skills**, 1982, 115 minutes, 7 part series on one tape. Addresses the following maintenance strategies: how to use specific tools, records, diagrams, and work with people, ways to approach mechanical and electrical problems, and hints for conducting planned and breakdown maintenance.

*015 is a new offering.

VIDEO ORDER FORM

NAME ______________________ ORGANIZATION ______________________

ADDRESS or P.O. ______________________

CITY, STATE, ZIP ______________________ WORK PHONE ______________

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3. ______________________

Preferred date of receipt ______________________

Return form to: DNRC, Energy Division; 1520 East Sixth Ave.; Helena, MT 59620-2301

Energy Training Workshops for Commercial Building Operators

Below are training opportunities available in early 1990 in the west and mid-west U.S. This list is not exhaustive, but merely a sample of the courses available in the commercial building management field. If you wish to attend a workshop on a specific subject and don't see it listed below, call DNRC at 444-6697. We may be able to connect you with a regional or national group offering coursework on that topic.

Neither DNRC nor the State of Montana endorses, recommends, or favors any product, service, or material offered by organizations or individuals listed in this training bulletin.

Washington

Washington State Energy Office, Olympia Contact Billie-Gwen Russell (206) 586-8077	Heat Pumps Tri-Cities January 9, 1990	Chillers Port Angeles January 26, 1990	HVAC Controls Vancouver February 14, 1990
Building Owners & Managers Assoc., Seattle Contact Ron Miller (206)622-8924	Energy Management January 4, 1990	Design, Operation & Maintenance of Building systems January 17, 1990	
Wash. Energy Extension Service, Seattle & Spokane Contact Jack Brautigan (206)296-5640	Fluorescent Ballasts Compact HID Lamps, Ballasts New Insulation Products Heat Pumps Boiler Controls	Energy Management Systems HVAC Fan Selection & Motor Sizing Seattle and Spokane areas Winter and Spring, 1990	
Washington State University, Pullman Contact Patricia Belmonte (206)840-4575	Organize & Manage a Preventive Maintenance Program Portland/Vancouver January 30-31, 1990		
Illuminating Engineering Society, Seattle Contact Rich Walkens (206)382-9410	Industrial Lighting Seminar Seattle January 18, 1990		
Bellingham Vo-Tech School, Bellingham Contact Walt Kirschman (206)676-6490	Computerized Heat Pumps Bellingham January 11, 1990	Fractional Horse-Power Motors Bellingham February 1, 1990	

California

Johnson Controls Corporation, Los Angeles Contact (800)JCI-8540 Costs: $935-$1,230	Electronic Systems-Building Managers Los Angeles January 15-19, 1990 Energy Management Engineering Los Angeles January 29-February 2, 1990 Air Conditioning Controls Los Angeles February 5-9, 1990	Variable Air Volume Control Los Angeles February 12-16, 1990 Electronic Systems-Operations Los Angeles February 26-March 2, 1990

Colorado

Honeywell Corporation, Denver Contact John Cain (800)367-4495	Basic Pneumatics Denver January 22-26, 1990

Wisconsin

University of Wisconsin, Madison Contact (800)262-6243	Boiler Plant Operation & Orientation Madison January 22-24, 1990 Cost $ 600	Efficient Maintenance Management Madison February 13-16, 1990 Cost $795

Technical Tips

Heating Boiler Start-up Checklist

A great many boiler failures take place at start-up or early in the heating season because of inoperative controls and safety devices. Most of these accidents could have been prevented if a little more attention had been paid to readying the equipment for service.

The Hartford Steam Boiler Inspection and Insurance Co. offers the following suggestions that will help avoid unexpected breakdowns.

1. Have a competent service representative disassemble the low-water cut-out and make-up water feeding devices. All parts should be thoroughly cleaned and reconditioned as required, then tested before the boiler is put into regular service.

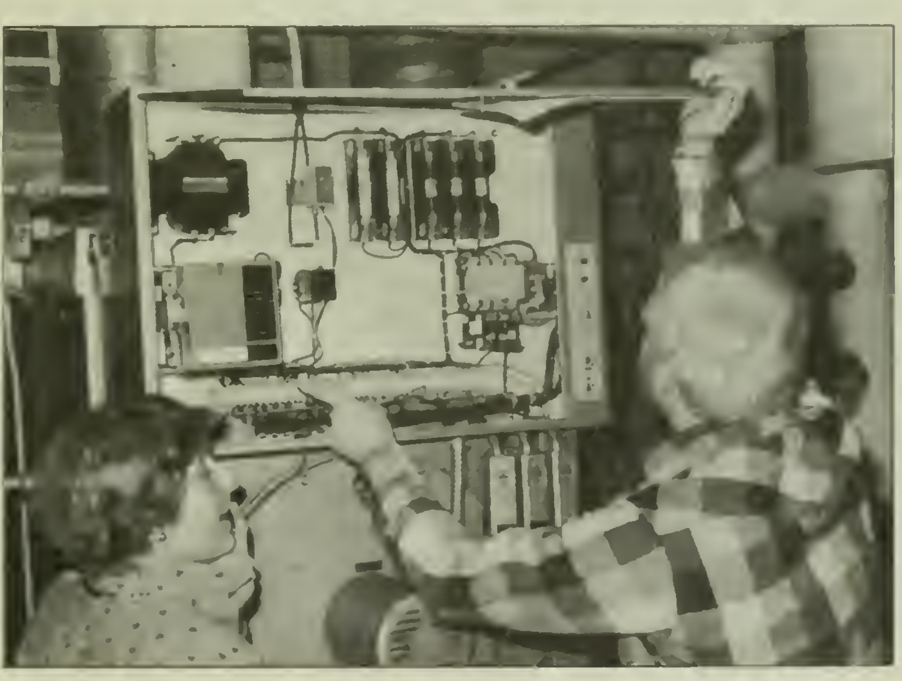
2. Burner equipment should be cleaned and adjusted to give maximum efficiency. This can save fuel dollars.

3. The boiler heating surfaces should be cleaned of all deposits. Dirty internal surfaces not only waste fuel and dollars, but also can lead to the burring, bulging, cracking, and even explosion of the boiler.

4. The safety/relief valve should be tested for freedom of operation. This is of primary importance. The boiler must not be fired if the safety/relief valve is inoperative or otherwise defective.

5. If the boiler is of a type designed to permit cleaning of the water spaces, this should be done, and where necessary, a suitable chemical treatment should be used to minimize new build-up of scale and to prevent corrosion.

6. All pressure and temperature controls and gauges should be checked for satisfactory operation and adjusted or replaced as necessary. The water-level gauge glass must be cleaned to indicate the proper water level at all times.



Staff look at a boiler relay panel in firing-mode position for DNRC building

7. Any leaking pipes or fittings located on the boiler or anywhere throughout the heating system should be repaired or replaced to prevent a loss of water.

8. Water lines exposed to freezing temperatures should be insulated to prevent freeze-up.

9. Steam and condensate return lines should be insulated to prevent unnecessary heat loss. However, this should be done with care because improper application of the insulation may cause problems with steam traps and the return pump. For more information, contact your manufacturer's representative or a consulting engineer.

10. All mechanical equipment, such as fans and pumps, should be checked for smooth operation and proper lubrication.

11. A suitable record of boiler operation should be established and maintained throughout the season.

Taken from Engineered Systems, Sept./Oct. 1989.

How to Write an Operations and Maintenance Manual

A carefully written instruction manual for the operation and maintenance of building systems and controls is crucial for good energy management. Here are some suggestions that can help you to prepare useful, effective documents.

Use clear, short, directive sentences to instruct personnel about operating energy equipment. Leave no room for misinterpretation, and tailor the instructions to the education and skills of the staff. Separate the complex technical specifications from the basic instructions on "what to do, when to do it, how to do it, and why to do it."

Use vinyl-covered, 3-ring binders, and put pages in plastic protectors for durability. Use separate volumes for each major system or for each building. Use photographs, when possible.

Include manual start and stop procedures and troubleshooting tips for new equipment, especially computerized controls.

Include system descriptions, design data, functional descriptions, operating guidelines, emergency procedures, and troubleshooting guides. For example, HVAC manuals should include the major elements of the load calculations, such as U factors, occupancy profiles, and weather data. Use flow diagrams.

Maintenance manuals should supplement, not duplicate, manufacturers' service books. Include inspection and service frequency, past maintenance records, parts replacement tendencies, spare parts data, and equipment lists with serial numbers and the telephone number of the parts supplier. Manuals should also contain—for each piece of equipment—a copy of documents such as blueprints and sketches that provide vital information.

The manuals can serve as training texts for employees. Require equipment manufacturers to provide training sessions for personnel for new equipment.

Ask for suggestions from your maintenance staff when drafting the manuals. During the first year in use, fine-tune the manuals as staff perform tasks on the maintenance schedule. They will likely find more information or revisions that are needed. If your building or facility is new, take advantage of the expertise of the architects, engineers, and building contractors. Rewriting or updating manuals every few years can be worth the effort. In the process of updating manuals, staff will often discover better procedures.

As a word of caution, when pertinent information is needed by staff for field use, it should be copied from the manual, and then used for the remote work. A lost or destroyed manual can be difficult and time-consuming to replace.

Based on guidelines prepared by the National Institute of Building Sciences.

Regional Energy Training Workshops

The insert sheet in this issue provides a list of regional and national training opportunities available to building operators and maintenance people. Please remember this is only a partial listing of the courses offered by various groups and educational institutions.

The next edition of *Energy Source* will include information about DNRC's training workshops that will be available in Spring 1990.

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February 1990

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Inside ...

The Department of Natural Resources and Conservation invites you to read its periodic bulletin, *Energy Source*. *Energy Source* offers practical information to managers and operators of commercial-scale buildings. This edition describes:

- Heart Butte's energy efforts
- Tips for water & steam systems
- Compact fluorescent lamps
- DNRC's training plans
- Highways' oil tank project

This issue is funded by the Department of Energy and the Bonneville Power Administration. We encourage your comments. Address them to:

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444-6697

Infiltration Problems Corrected

Conservation Efforts Save Energy at Heart Butte

For Heart Butte School, located in the frigid and windswept foothills of the Rockies 35 miles south of Browning on the Blackfeet Indian Reservation, the conservation of energy is more than an academic concern.

The school, a modern structure built in 1981, is partly underground to protect it from the wind and cold. Most of the building is fairly well insulated with 2- or 4-inch polystyrene or 6- or 9-inch fiberglass. R-values run up to 37. All windows are double pane. Electricity is used for all heating, air conditioning, and ventilation. Insulation and the heating and cooling facilities were designed to complement the earth-sheltered design, but problems have plagued these systems in the years since the building was built, driving up energy use. In the year between July 1, 1984, and June 30, 1985, the school complex consumed 1,426,050 kilowatt-hours (kWh) at a cost of $35,651.

Alarmed by these high bills, school officials were glad to learn about Bonneville Power Administration's Institutional Building Program (IBP). During its operation from 1982 through 1989, IBP channeled Bonneville money into electricity-saving projects in public institutions in the Northwest. Heart Butte was awarded an IBP grant for the analysis of the school's heating and cooling system and for the installation of several energy conservation measures. The grant was administered by the Montana Department of Natural Resources and Conservation.

The engineering analysis of the school determined that more than 60 percent of the space heating load was caused by infiltration of outside air from leaky doors and lack of building pressurization. The doors were leaky due to inadequate weatherstripping and undercutting of the main entry doors. Cabinet unit heaters in the entry vestibules operated continuously during cold weather to combat the cold air coming under the doors.

Lack of building pressurization was caused by defects in the air handling system, making it easier for outside air to enter.

(continued on page 2)

School courtyard entrance on left leads to earth-sheltered classrooms. Earth-bermed gym is on right.

PLEASE RETURN

(Heart Butte, continued)

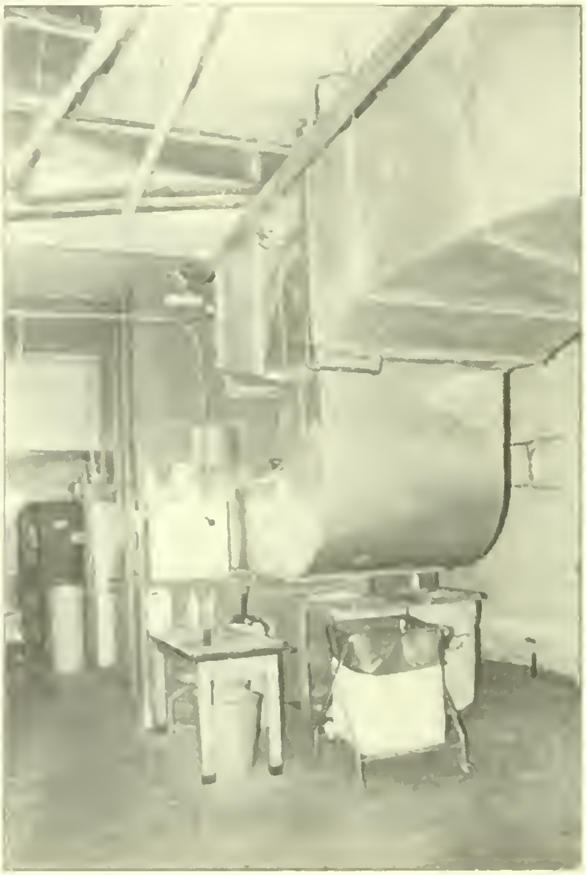
Another source of energy waste was the failure to use the time clocks and optimizers that had been installed to set back the temperature during unoccupied periods and to warm the rooms before use. The maintenance staff felt these controls were not working properly and disabled them. The engineering analysis recommended that the time clocks and optimizers be used in the gymnasium and entryways, which would save 93,349 kWh, or $2,530 at 1988 electricity costs.

Other improvements suggested were reducing hot water temperatures, using lights only when and where necessary, and replacing existing incandescent lights with fluorescent lights when they burn out.

In all, the engineering analysis recommended 12 operation and maintenance (O&M) changes to improve energy efficiency. These changes ranged in cost from $2,388 for weatherstripping and replacement of door seals to zero for such measures as reducing hot water temperatures and increasing thermostat cooling settings for air conditioning in the administrative wing of the building. Simple payback periods ranged from zero for the no-cost measures up to 2.8 years for installation of equipment to lock out heat in kitchen ventilation. The O&M changes were expected to save about 212,000 kWh per year, for a cost saving of about $5,300 per year at 1985 electricity rates.

More elaborate measures pressurized the gymnasium and classrooms and modified the classroom temperature setback and quick warmup equipment to make it operate properly. The school also installed rubber sweeps on the bottoms of the entry doors, which stopped most infiltration at that point.

The last measure was to install controllers to manage the recirculating pumps and temperature settings on the hot water heaters.



Ductwork for classroom air handling system

Total cost of the conservation measures was $15,463, of which Bonneville paid $12,310 and the school paid $3,153. Payback estimates ranged from 16 years for the entry infiltration measures to 2.7 years for classroom setback and quick warmup.

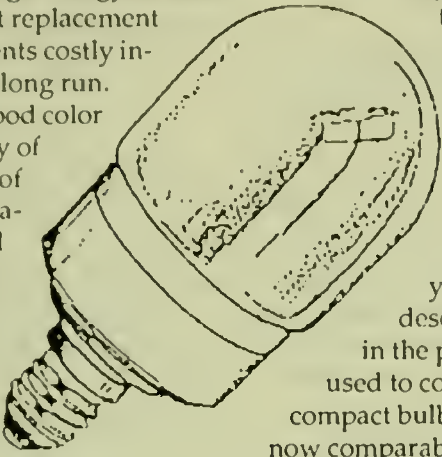
All but three of the minor O&M measures were completed by March 1987, and energy monitoring began. Measured savings the first year, compared to 1985 energy use, were 452,250 kWh, a cash savings of $11,306. Colder weather and longer operating hours due to more building use in 1988 reduced savings to 285,920 kWh, but cash savings were still $7,148. The percentage of kWh savings was 32 percent in 1987 and 20 percent in 1988.

Now that the school's energy efficiency measures are operating properly, school superintendent Dale Shupe is enthusiastic about the resulting comfort and energy savings. He said the school is well designed for the rigorous weather. Even the fierce chinook winds that roar down from the mountains roll harmlessly over the building, Mr. Shupe said, adding he doesn't even notice the wind unless he looks out the window. The school has also shown it can't be frozen, despite the combination of extreme cold and power failure. Mr. Shupe said that in February 1989, the chill factor was about 60 below when the electricity went off and stayed off for more than a day. After 35 hours without heat, the temperature in the school bottomed out at 45 degrees. When a new classroom building is needed to accommodate more students, Shupe said, it should be built along the same line as the present building.

Bonneville's IBP program is no longer in operation. However, DNRC has prepared case studies documenting the success of several IBP projects in Montana, such as an in-depth report that describes the conservation measures at Heart Butte. If you wish to receive a copy, call 444-6697 and ask for the Heart Butte School Case Study.

Compact Fluorescent Lamps Can Replace Incandescent

Incandescent lamps in commercial buildings are expensive. Although they often cost less than a dollar to purchase, their high energy use and need for frequent replacement make incandescents costly investments in the long run. Until recently, good color quality, flexibility of design, and lack of acceptable alternatives often forced building owners to rely on incandescents.



Now, however, there is an acceptable alternative—the compact fluorescent lamp. These new lamps offer substantially longer life and significantly less energy use. And they provide good quality light and design flexibility.

Longer Life and Lower Maintenance Costs

Incandescent lamps typically operate for 750 to 1,000 hours, about three or four months of night-time operation. Even long-life bulbs last only 2,000 to 3,000 hours, and longer life means less light output per watt. In contrast, compact fluorescents are rated for 7,500 to 10,000 hours of normal operation. Also, substituting compact fluorescents for incandescents can mean cutting lamp replacement labor five to ten-fold. In large commercial facilities it is not uncommon for one person to work full time replacing burned-out light bulbs.

Wide Range of Applications

Compact lamps can be used in a variety of fixtures and locations. If a fixture can hold an incandescent lamp, there is probably a compact fluorescent shape that will fit. Compact fluorescent lamps are available in sizes from 5 to 20 watts with light output ranging from 250 to 1,100 lumens.

One of the most common complaints about fluorescents is that they do not provide the high-quality, warm light you get from an incandescent. Due to advances in the phosphors that are used to coat the inside of the compact bulb, the color quality is now comparable to incandescents. In enclosed fixtures, building occupants are often unaware that compact fluorescents have been substituted for incandescent.

Manufacturers are now placing many compact lamps into reflective lamp enclosures. These fluorescent reflective lamps can be used in locations where R or PAR incandescents are currently in use. However, before replacing all your recessed-can reflectors with fluorescent, try it out in a few test areas. Although the reflective enclosure can greatly improve the light dispersion patterns of the compact fluorescent, an exact match to the original R or PAR lighting pattern is nearly impossible. A few tests will help determine whether the fluorescent replacement will work in your situation.

Significantly Less Energy Use

Generally, you can replace an incandescent bulb with a compact fluorescent one-fourth to one-fifth the wattage. For example, a 60-watt incandescent can be replaced by a 13- to 15-watt fluorescent with little or no loss in light output.

A quick calculation (based on $0.0258/kwh) shows that 100 60-watt incandescent lamps operated 3,000 hours per year would cost $465/year in energy--not including any demand charges or lamp replacement costs. Comparable 15-watt compact lamps would cost less than $120/year to operate.

A Word About Cost

Initial costs for compact lamps are high. The PL lamp and ballast combination can cost $12 to $15 dollars. The addition of an R/PAR enclosure can add another $5 or more. However, prices have decreased in recent years. Shop around and you should be able to get a good price, especially if you buy in quantity.

—from the Summer 1988 Energy Access newsletter produced by the Washington State Energy Office

Compact Fluorescent

Compact fluorescent lamps are designed to be as bright as many incandescent lamps currently being used, but these fluorescents operate at very low wattage. Incandescent bulbs typically require 40-75 watts of electricity and last about 1,000 hours, while compact fluorescents use 9-25 watts and last about 10,000 hours. The new fluorescent lights can often help managers reduce building maintenance costs and result in lower electricity bills.

Technical Tips

How to Improve the Efficiency of Hot Water and Steam Heat Systems

The following will help users increase the energy efficiency of their hot water and steam heating systems, according to Dr. Robert Matthai, formerly associated with New York City's Hall of Science.

1. Clean the exterior surfaces of all direct radiators, heating coils, fins, and tubes frequently. Preventing dirt and dust build-up will enhance heat transfer.

2. Keep all radiators free of blockage. A 1-foot clearance in front of convectors, radiators, and registers is recommended. The tops of horizontal shelves or cabinets that enclose radiators, fan coils, unit ventilators, or induction units should be free of clutter that could block heat or air delivery.

3. Reduce radiation losses from radiators set directly next to windows or uninsulated exterior walls. Insert a 1-inch thick fiberglass board panel between the radiator and window glass or wall. Make sure the panel's reflective coating faces the radiator.

4. Install air vents on all hot water radiators and convectors. This will ensure that water will completely fill the interior passages.

5. Maintain the minimum temperature required to prevent freeze-up and icing problems in vestibules.

6. Add louvers to overhead heaters to redirect heat to the floor or other areas that need heat. Draw return air up from the floor whenever possible.

7. Use supplemental electric or infrared spot heaters for remote areas, such as reception desks in large lobbies.

—*Energy User News Booklet, Checklist Collection*

Training Priorities for Building Operators

DNRC's Energy Division is preparing several training opportunities for Montana's commercial building operators. The topics that will be offered were selected after talking with building managers and operators and reviewing comments from workshop evaluations and responses to last June's survey in *Energy Source.*

DNRC will offer boiler training in late spring. The boiler workshops will include one day of instruction on boiler efficiency and one day of training on water treatment. We expect to conduct two boiler/water treatment workshops, one in the western part of the state and one in the east.

Training in preventive maintenance will be offered later in the year. The content and instruction of the sessions are still in the design stage. Watch future issues of *Energy Source* for dates and locations for the boiler and preventive maintenance workshops.

DNRC will charge a registration fee for this year's workshops. The fees will supplement state funds and help DNRC offer commercial building operators maximum training opportunities at an affordable cost. Fees will vary according to workshop length and DNRC's costs of providing the training.

Thanks to those who have helped shape our training programs for building operators. We encourage anyone who has comments or suggestions regarding training to contact:

Chris Picotte, DNRC
(406)444-6751

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Inside ...

The Department of Natural Resources and Conservation welcomes you to *Energy Source*. This issue highlights:

- Refrigerants and CFCs
- Conservation grants available
- Tips on motor maintenance
- New video opportunities

Funds are being provided by the Department of Energy and Bonneville Power Administration. We encourage your comments. Send them to:

Peggy Nelson
Department of Natural Resources and Conservation
1520 East Sixth
Helena, MT 59620
444-6697

Cooling Systems Caught in CFC Crunch

The beginning of a new decade brings with it a lot of news about the use of coolants in chillers and air conditioners. Building operators are closely watching these developments because many commercial-sized cooling systems use chlorofluorocarbons (CFCs) or their chemical relatives as refrigerants. A new international treaty, called the Montreal Protocol, recognizes CFCs as a hazard to the environment and targets them for elimination.

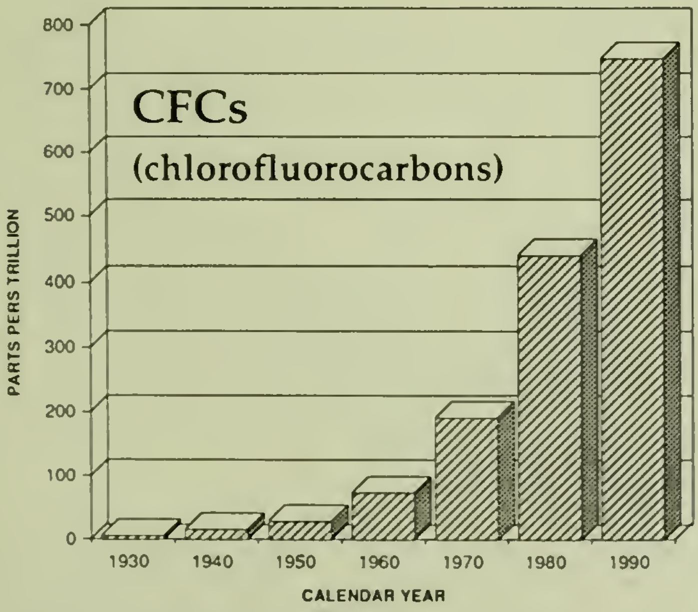
The protocol requires U.S. production of CFCs for domestic use to be reduced 20 percent below 1986 levels by 1993 and 50 percent by 1998. The U.S. has already reduced its production of CFCs for domestic purposes by 15 to 20 percent compared to 1986 levels. In January 1990, a federal tax was imposed that more than doubles the cost of CFC refrigerants. This tax is intended to encourage users to switch to alternative refrigerants.

CFCs are a family of human-made chemicals containing chlorine, fluorine and carbon. They are nonflammable, noncorrosive, nonexplosive, and have a low toxicity level. They are used in air conditioners and refrigerators as coolants, in solvents for cleaning metals and circuit boards, and in foam for insulation, furniture, and many other products. According to the American Society of Heating, Refrigeration and Air Conditioning Engineers Journal, 715,000 people are employed in CFC-related jobs in the U.S., and more than $135 billion of equipment installed in the U.S. is dependent on CFCs.

CFCs are a big culprit in the depletion of the ozone layer, which filters out much of the sun's harmful ultraviolet rays. When CFCs escape into the air, they drift through the atmosphere to the ozone layer 15 to 22 miles above the earth. There the sun's unfiltered rays destroy the CFC molecules releasing their chlorine atoms. One chlorine atom can destroy 100,000 molecules of ozone.

Between 3 and 7 percent of the ozone layer has already been depleted by human-made CFCs and related chemicals. Many physicians and scientists think the effect of depleted ozone is already being seen in increased incidence of skin cancer. Other effects may include climatic changes, reduced yields of crops and other plants, suppression of immune systems and an increase in cataracts in humans and animals, and damage to aquatic ecosystems.

(continued on page 2)



The atmospheric levels of the two most common chlorofluorocarbons—one used primarily as a refrigerant and the other as a foam-blowing agent—continue to increase by about 5 percent each year.

PLEASE RETURN

(CFCs, continued)

Controversy over the phase-out of CFCs no longer centers on whether they should be eliminated, but when they should be phased out. Eliminating CFCs is a balancing act between preserving a livable environment for future generations, maintaining living standards in developed countries, and improving living standards in third world countries.

The number of suitable CFC alternatives is limited because of problems with efficiency, toxicity, and flammability. Proposed substitutes are often incompatible with lubricants and seals used in chillers today. Others discharge at different temperatures or require higher operating pressures than the CFCs they replace. Preliminary findings indicate the alternatives won't work without some equipment or lubricant changes. Hardware modifications will be needed to optimize thermal performance of equipment using these fluids. In some cases, a complete system replacement may be required.

Also, because they are more complicated to produce than CFCs, the new products require major capital investments. A number of alternative products will be commercialized in the early to mid-1990s, but it will still take several years to convert equipment and processes to use them.

The most commonly proposed short-term alternatives are the hydrochlorofluorocarbons (HCFCs). HCFCs are 20 to 100 times less destructive to the ozone layer than CFCs, but they too may eventually be targeted for elimination. The alternatives are generally less efficient, and the resulting increase in energy use may cause an increase in carbon dioxide emissions.

Two frequently mentioned HCFC alternatives are known as R-22 and R-123. R-22 is now available, but compared to the CFCs it replaces, it is less efficient and operates at higher pressures. R-123 will soon be on the market. It is much more toxic than the refrigerants it will replace, so it requires better ventilation and leakage monitoring. It's an aggressive solvent that attacks rubber and other materials in gaskets and seals, erodes insulation on motor windings, and attacks the varnish on hermetic motors.

CFCs and Preserving the Ozone Layer

- When a home air conditioner is serviced, the CFCs should be drained. Storing the coolant in a closed container will prevent it from evaporating. It should be taken to a refrigeration firm or appropriate source to be recycled. Also, many refrigerators and freezers contain CFC coolants. This same procedure should be followed when a refrigerator or freezer is taken out of service, and when a vehicle with an air conditioner is junked or otherwise disposed of.

- Many fire extinguishers use halon. Halon contains bromine, a chemical that destroys ozone. Extinguishers that don't contain halon are available, and purchase of those should be considered.

Some building operators are installing gas chillers that rely on inert salt solutions, such as lithium bromide. The gas-fueled chillers are typically less efficient than centrifugal chillers, but the lowered fuel costs may provide a good payback in many instances. However, the fuel cost advantages must be weighed against higher first costs for equipment. The higher first cost can be a significant obstacle in smaller systems, such as dehumidifiers, small engine-driven chillers, and units relying on desiccant cooling.

Energy managers are aware that there are no fool-proof, short-term answers available now. The solutions are coming, but many of the problems caused by elimination of CFCs are complex and yet to be resolved.

Replacement of CFCs

Alternative refrigerants to CFCs are arriving on the market. However, these substitutes can't simply be placed into a system designed to use CFCs. Most alternatives are similar, but not identical to the CFCs they are intended to replace. The differences in physical properties must be considered carefully because systems designed for CFCs may perform inefficiently or fail completely if improperly retrofitted with an alternative refrigerant.

Before an alternative is considered for a CFC system, determine whether the new coolant has any dangerous or damaging characteristics. Make sure the coolant is compatible with the seals and other materials it will contact in the cooling system. Any changes recommended by the equipment manufacturer should be made to ensure the system will perform correctly and efficiently. The changes needed to adapt a system to an alternative refrigerant may range from replacing the oil to replacing the elastomers and plastics throughout the system.

REQUEST FOR INFORMATION

Energy conservation grants for schools and hospitals

_______ Yes, please send us an information packet about the grants offered through the Institutional Conservation Program (ICP).

_______ Our facility is a non-profit school.

_______ Our facility is a non-profit hospital.

Institution name ______________________________

Institution address or P.O. ______________________________

City, State, Zip ______________________ Work Phone ______________

Name of facility's energy manager ______________________________

Your name ______________________________

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DEPARTMENT OF NATURAL RESOURCES
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Money Available for Energy Conservation Grants

Montana schools and hospitals will share between $900,000 and $1.5 million in the coming year to help cut their energy bills. The total available will depend on the exact amount of federal and state dollars being allocated to the Institutional Conservation Program (ICP).

The Montana Department of Natural Resources and Conservation will accept applications for ICP grants until December 1, 1990. There is no cap on the amount of each grant application, but the dollars awarded to each grantee will be affected by the number of applications received. Awards will be made in time to allow construction of most projects to start in spring 1991. The grants provide 50 percent matching funds for energy conservation measures in schools and hospitals built before 1977.

Funded by the U.S. Department of Energy, ICP is administered in Montana by DNRC. Since 1978, more than 160 Montana institutions have received over $6.6 million in ICP grants. The funds were used for energy-saving measures that have cut the institutions' energy costs an average of 26 percent.

"Lowered fuel costs mean more funds for classroom materials and teachers or maybe even lower taxes," said DNRC's Jeanne Doney. "ICP is a great opportunity for every school and hospital in Montana to set goals for saving energy and money and also to receive financial help in reaching those goals."

For schools and hospitals that haven't participated in ICP before, Doney said, the first step is a detailed engineering analysis of the building's thermal performance and architectural design. The engineering report will identify the most cost-effective energy-saving measures for the building. Measures that will pay for themselves in energy savings in 2 to 10 years are eligible for grants.

ICP grants sometimes are available to cover the cost of the technical analysis, but the school or hospital will then have to wait until the following year to apply for an ICP grant to implement energy conservation measures. Some schools and hospitals opt to pay for the technical analysis themselves so they can apply for grants to do the energy conservation work in the current year. One-half of the institution's cost for the study can be applied toward its 50 percent share of the cost of the energy conservation work.

Schools that had technical analyses done in previous years can apply directly for energy conservation grants.

Funding is on a competitive basis, Doney said. The proposed conservation measures are evaluated on the basis of 1) payback; 2) conversion to a renewable resource, cogeneration, or coal; and 3) the quality of the technical report.

The funds for ICP grants vary from year to year, Doney said. "The amount available for 1991 is three times the amount that was available this year. So this is an especially good time for schools and hospitals to apply for funding. We'd like to work with each hospital and school district in the state to help them get funding for energy projects."

For more information, mail in the enclosed form or call Connie Onstad at 444-6697.

1990 is an
election year.
Please register
to vote.

DNRC to Offer More Videos

Many of the most effective energy-saving measures for commercial and institutional buildings rely on maintenance personnel to carry them out. The training these people receive is often vital to the success of such energy conservation programs.

DNRC's video library can train maintenance personnel without the travel and expense often associated with workshops. And unlike workshops, videos can be used at the operator's convenience and viewed several times to reinforce an idea.

The commercial video library was established in 1988 and has grown to 15 titles. In the last 18 months, DNRC has sent more than 360 mailings of tapes to building officials for training. DNRC estimates that an average of three people view the tapes each time they're checked out, and more than 1,000 individuals have benefitted from this service.

DNRC is acquiring another 20 videotapes. Topics include thermostats, air-handling units, air conditioning, hydraulic pumps, water chemistry, and boilers.

The new tapes will be available by mid-summer for loan to Montanans. Watch for more information in upcoming issues of *Energy Source*.

Technical Tips

Maintenance Tips for Motors

Inspect motors twice a week, once when they have been operating at full load for two hours, and again when the motors have been inoperative for several hours. This procedure will help identify motor stress caused by operating conditions.

Before making an in-depth examination:

- See that the motor's air vents are clean and the fan is operating properly.
- Check the terminal box. The conduit should be firmly attached and the box sealed to the motor frame.
- Check the tension on belts and couplings. The couplings should be aligned and the belts unfrayed.
- Inspect the motor mounting for missing or loose bolts. Also, check for excessive vibration of the base.

To identify the temperature of the motor's windings, take temperature measurements at different parts of the frame. Readings above 200 degrees F. may indicate an impending motor failure. When installing motors, remember the higher the surrounding air temperature, the less readily a motor can shed excess heat.

Regularly inspect the motor conduit. Measure the amperage of each phase. The amperage draw of a motor shouldn't vary more than 5 to 10 percent between phases. If the phases are out of balance, contact a licensed electrician. A problem with low power factor, motor overload, or voltage supply may exist. Generally, a motor is achieving peak electrical efficiency when it is operating at 70 to 90 percent of the nameplate amperage reading. However, power factor will become a concern below 75 percent of the nameplate current draw.

Listen for excessive noise in the switchgear. A loud noise may indicate a weak relay, which could cause the motor to switch off or have difficulty starting.

Keep orderly records on motor performance and service. Single inspection measurements are of little value if this information isn't compared with historical records. A written log of motor replacements helps staff keep track of which motors have been replaced.

Taken from Energy User News "Checklist Collection".

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Helena Churches Cut Heating Bills

A three-step program has cut the heating bills at St. Peter's Episcopal Cathedral in Helena by about $2,000 a year.

Church officials first took interest in their heating system when they were unable to make the church comfortable for Sunday services.

"If you turned the furnace on Saturday night, it was too hot," explained the Very Reverend Arch M. Hewitt, dean of St. Peter's. "If you turned the furnace on Sunday morning when you arrived for the first service, it was too cold. So someone was coming down at 5:30 a.m. every Sunday to turn on the furnace."

"The radiator valves stayed wide open no matter what you did to the thermostat," Hewitt said. The system works much better since they cleaned and repaired the valves and steam traps and installed a zonal heating system.

Arch M. Hewitt, dean of St. Peter's Cathedral.

"We've got thermostats all over creation," Hewitt chuckled, adding that the system allows him to keep unused rooms cool and at the same time warm the occupied portions of the building. "We keep the office wing going six or seven days a week. We have a bargain basement resale shop open from 10:30 a.m. to 3:00 p.m. five days a week, and that has to be heated. Then we have the regular round of meetings most churches have, but most of them are in the evening."

The thermostat system now includes a seven-day timer which automatically turns the heat up so the cathedral is comfortable when parishioners arrive for services Sunday mornings.

The second step in St. Peter's energy program came five or six years ago when the boiler sprang a leak. "The boiler had been installed when the church was built in 1931," Hewitt said. "It had been converted from coal to gas, and it was a gas guzzler. It had been patched several times, and it was getting dangerous. We were especially worried that it might go out during the winter. We had a fundraising drive and replaced it with a state-of-the-art, energy-efficient new boiler. It's marvelous, and we expect the new boiler will pay for itself in heating bill savings in 10 or 12 years."

(continued on page 2)

Inside ...

Welcome to the Department of Natural Resources and Conservation's bulletin, *Energy Source.* This edition features:

- Churches reduce heat bills
- ICP energy grants
- Tips for boiler shut down
- Upcoming boiler training
- New videotapes available

A thanks goes to our sponsor, the U.S. Department of Energy. Send your comments or other correspondence to: Peggy Nelson, DNRC, 1520 East Sixth Ave., Helena, MT 59620; 444-6697.

PLEASE RETURN

(Churches, continued)

The third step was to install insulated shades in the office wing. "That's the only part of the church where we keep the thermostats at a comfortable range every day," Hewitt explained.

The church is now working on a fourth energy-saving project: replacing the single-glazed windows in the parish hall with double-paned thermal windows. The new windows were specially built to match the original round-topped windows, he said.

A few blocks away, St. Paul's Methodist Church also has installed a zonal heating system that has helped reduce heating bills. The new system includes a timer to "make sure the heat gets turned off in the evening," said the Rev. David Orendorff.

"We added insulation in some spots, and we put insulating foam pads over the windows in the basement and in rooms that aren't being used," he said, adding that the church also added storm windows to its original single-glazed windows. The most effective step St. Paul's took in cutting its energy bills, he said, was having an energy survey done by the local utility.

"Montana Power Company came out and did an energy survey for us several years ago," Orendorff said. "They didn't charge us anything for it, and it was very worthwhile. I'd recommend an energy survey to any church."

WMC to Offer Boiler Training

Western Montana College (WMC) will conduct a five day course called "Low Pressure Steam Boilers and Systems." Scheduled for June 25th - 29th, this workshop is aimed at individuals who wish to prepare for their boiler operators license. After 4 1/2 days of classroom study, participants will take an exam to become licensed boiler operators. Mr. Terry Meehan, a hydronics consultant from Lewistown, will be the instructor. The course fee is $110, plus textbook, meals, and lodging. For more information, call Vicki Lansing at WMC, 683-7537.

Technical Tips

How to Prepare Boilers for Off-season Storage

The following procedures should be followed by users who intend to store boilers for the summer months, and are adapted from a seminar offered by the Boiler Efficiency Institute, Auburn, Alabama, according to Glenn Maples, vice president.

Open the boiler and clean the water tubes thoroughly. Both the water side and the fire side should be hosed. If any deposits are left on the water tubes, clean them with acid-removing chemicals. If simple hosing cannot remove the debris from the tubes, this will indicate that the boiler's water treatment method is not performing efficiently, in which case the boiler's makeup water will have to be fed through a water softener.

Clean all safety controls in the boiler. The water level controls should receive special attention. Repair any damaged refractory material. Once cleaning and repair are complete, fill the boiler up to the operating level with water. Make sure that the water has adequate sulphite levels—100 parts per million. The water should be between 8 and 10 pH.

Fill the boiler completely. Close off all valves and lines into the boiler—remove or gag them. Fix the boiler pressure at 1.5 times operating level. Using a pump, the user should be able to detect whether there are any leaks and to determine that the joints of the boiler are sound. These measures constitute the "hydrostatic test" that most states require by law following the opening or repair of a pressure vessel.

Drop the water level back to the operating level. Build a fire in the boiler. Check the relief valves under operating conditions to make sure they are opening when boiler pressure exceeds the levels at which it stops firing.

Turn the boiler off. Never let the pressure go down to zero because under these conditions, the boiler will pull in outside air, which can damage the tubes.

Override the high-level cutoff control and fill the boiler up again to the top valve. Maintain water pressure of a few pounds during storage to prevent corrosion. However, if there is any way for the boiler to freeze, store it dry.

Cap the stack. Close all dampers. Put a desiccant—a silicate gel or lime—into the firebox to keep humidity low on the fire side. This will prevent corrosion from moisture.

Seal the air intake to the fire box with a plastic bag. This will prevent air from flowing through the fire box by natural draft.

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New Energy-saving Developments

Recent advances in energy technology hold promise of improved efficiency and cost savings for schools, hospitals, and other institutions. Many of the new energy-saving techniques are compatible for retrofit projects in Montana's institutional or commercial buildings.

Heating

Boilers can be operated more efficiently by combining advanced sensing equipment with computerized controls, saving up to 15 percent annually on fuel. Boiler economizers that take heat from the exhaust gases and return it to the boiler can recover an additional 10 percent of the fuel's energy content.

Closed-loop heat pumps are ideal for multi-zoned buildings that require both heating and cooling. However, remodelling a building with heat pumps is expensive and may be feasible only for major renovations and additions, or for use in new construction.

Cooling

Motor controllers with variable frequencies can regulate motor speeds on compressors and blowers to make them more efficient. These are coming down in price and will continue to be a practical way to conserve energy in commercial buildings with space cooling loads large enough to benefit from them.

Ventilation

Ventilation fans can also run more efficiently on variable-frequency motors. These motors are used primarily in buildings with central ventilation systems. However, the baseboard or fan-coil heaters and coolers used in many Montana buildings are often incompatible with variable-frequency controllers. Solid-state speed controls can be used to improve the efficiency of fan-coil motors.

Domestic Water Heating

In many buildings, domestic hot water is typically heated by passing it through heat exchangers attached to distribution loops on the space-heating boilers. Many building operators are switching to pulse combustion water heaters which can be operated alone or in series to meet the domestic hot water demands of large buildings.

Highly efficient combustion heaters are being marketed, but these heaters condense water from combustion gas, requiring a drain for the condensate and corrosion-resistant vents to provide combustion air.

Lighting

Low-wattage, screw-in fluorescent lights are widely available and can replace most incandescents, saving energy and maintenance time. In buildings with overhead fluorescent fixtures, standard ballasts can be replaced with electronic ballasts to save energy. Electronic ballasts have dropped in price, while their quality has improved.

Improved lighting controls–including room timer switches and light sensors—can be cost effective in many buildings, though they are best suited to large institutions.

Windows

When replacing single-pane windows, double-pane Low-E windows are slightly more cost effective than standard double-panes. Low-E windows are better at reducing heat transfer, but the labor and material costs of remodelling with Low-E windows will outweigh the energy savings. In new construction, Low-E windows offer significant, cost-effective energy savings, particularly in air conditioned buildings.

Cogeneration

"Cogeneration" is the simultaneous production of heat and electricity in a single operation. Cogeneration in Montana is typically based on powering a generator with high pressure steam from natural-gas boilers. The low pressure steam is then used for heating. Several cogeneration systems are operating in Montana, mainly on a large scale, such as at Montana State University. The Stone Container plant in Frenchtown generates electricity with its wood-fired boilers.

Smaller systems are making their way into the market, but Montana's low electric rates, limited electricity use, and seasonally varying loads make cogeneration uneconomical. Cogeneration may become more feasible if utility rates rise.

Photovoltaics

Photovoltaic cells, which convert solar energy into electricity, show long-term promise. In recent years, photovoltaic systems have increased in efficiency and declined dramatically in cost. For now, however, photovoltaics are not cost effective for most Montana institutions.

This article is based on a 1988 study by the U.S. Department of Energy. For more information about the above technologies, contact Georgia Brensdal, Engineering Supervisor, DNRC, 444-6697.

ICP Funds Help Ennis School Save $5,000 a Year

The Madison Valley Consolidated School District in Ennis cut its fuel oil bills by $5,000 to $6,000 a year by adding insulation to the walls of the high school gym.

"The extra insulation has decreased our energy consumption substantially," said School Superintendent Tom Warwick. "It'll take about two and a half years for the insulation to pay for itself in energy savings."

In 1988, Matney Frantz Engineering of Bozeman carefully studied the high school and elementary school buildings in Ennis and recommended several energy saving measures. One of the engineers' recommendations was to blow 11 inches of fiberglass insulation into the upper walls of the high school gym, boosting the insulation from R-2 to R-32.

The insulation project cost $18,000. The school system received $9,000 from the Institutional Conservation Program (ICP) for the project and covered the rest of the costs itself.

Federally funded, ICP is administered by the Montana Department of Natural Resources and Conservation. The program provides 50 percent matching funds for energy conservation measures for schools and hospitals built before 1977.

ICP Funds for Your School or Hospital

This year Montana schools and hospitals will share between $900,000 and $1.5 million under the Institutional Conservation Program. ICP will provide up to 50 percent of the cost of installing energy conservation measures on schools and hospitals built before 1977.

The deadline for applications for ICP funding is December 1, 1990. For more information about the program, contact Connie Onstad at DNRC, phone 444-6697.

"ICP is an easy way to get some energy projects done," Warwick said. "The program requires a little paper work, but it's not unreasonable at all. The people we have worked with at DNRC were very helpful and thoughtful. We're a small school system and work with ICP once or twice a year, so we don't remember all the details; the people at DNRC were willing to go back over everything for us each time. They were extremely polite and helpful."

ICP is helping fund several other projects at the Ennis schools. "We just completed a double-door entry on the front of the lobby of the high school," Warwick said. "It looks very nice. And it's going to save us a pile of money because we have hundreds of kids going in and out of those doors every day."

Warwick will use ICP funds later this year to help replace a 40 percent efficient boiler with a new, energy-efficient model and to put storm windows on the elementary school.

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Energy Source
For Commercial and Institutional Building Operators
October 1990

Hints for New Boiler Operators

The following question is heard many times during the heating season. Greg Ennen, manager of boiler machinery engineering in the Hartford Branch Office of the Hartford Steam Boiler Inspection and Insurance Co., provided this answer in "From the Field," a column in his firm's quarterly publication *The Locomotive.*

Q: In addition to my other duties at work, I recently became responsible for our boiler. I have no experience with boilers and would appreciate any help you could provide. The boiler is used to heat our business. Can you help me?

A: The predicament you are in is all too common. You have been given responsibility for boilers and equipment that are critical to continued operation of your business. However, you have been given no training to prepare you for the task. Many times our inspectors investigate accidents that could have been prevented with some knowledge of the equipment.

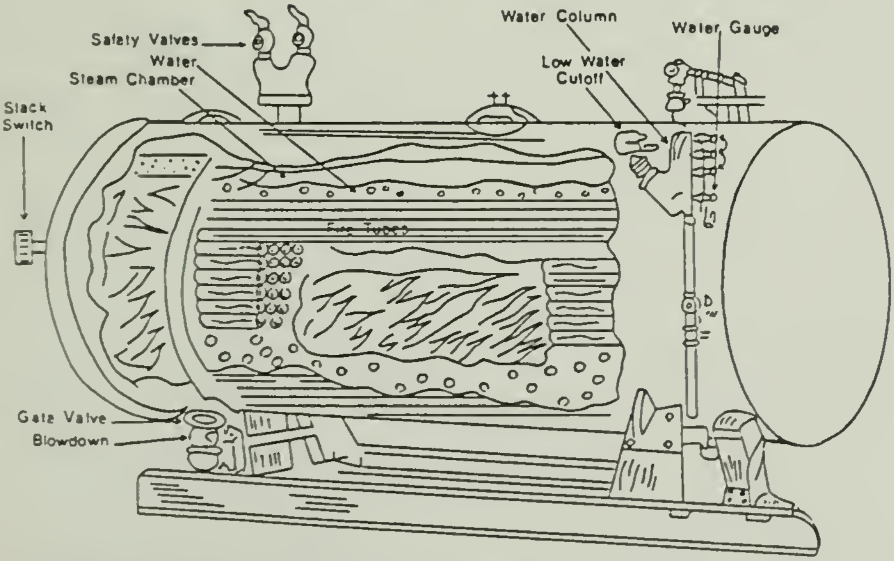
You mention the boiler is used to heat your business. Heating boilers are generally low pressure boilers. The boiler may be constructed of either steel or cast iron, and can be further classified as either providing steam or hot water. The type of burner and fuel burned will affect the type of safety controls on the boiler.

All boilers are equipped with either a safety valve (steam) or a relief valve (hot water). Often there is more than one installed. These are found on the upper portion of the boiler. The safety valve, or relief valve, is the single most important safety device on a boiler. These valves are designed to protect the boiler should other controls fail to shut it down.

Safety and relief valves should be tested regularly. Monthly, lift the test lever on the valve to assure free and unrestricted operation. This should be done with the boiler under pressure. Should the valve not operate properly, or show evidence of leakage, contact a heating contractor or boiler repair firm to replace it. Do not attempt to adjust the valve or tamper with its components. Leave this for experts.

All steam boilers should be equipped with at least one (preferably two) low water fuel cut-out controls. These controls shut off fuel to the burner when water level drops below a safe level. Hot water boilers should also have this safety device.

The cut-out should be tested regularly during the heating season. It should also be disassembled and cleaned once a year when your boiler is shut down. Usually, failure of the low water fuel cut-out is a result of improper maintenance. Poor maintenance is the leading cause of boiler accidents.



Example of a Scotch marine boiler and valves—courtesy of the Safety Bureau, Montana Department of Labor and Industry

(continued on page 2)

Inside...

The Montana Department of Natural Resources and Conservation publishes *Energy Source* several times a year with funding from the U.S. Department of Energy. This edition features stories on:

- Funds for energy conservation projects
- Hospital energy savings
- Free videotape library
- Free publications
- Boiler water treatment

Address your comments and suggestions to Pat Hoban, DNRC, 1520 East Sixth Avenue, Helena, MT 59620-2301; phone: 444-6697.

(Boiler hints, continued)

Once a week, the low water cut-out should be drained according to the manufacturer's instructions to flush out accumulated sediment. If an excessive amount of sediment is noticed, it should be flushed out more frequently.

At least once a month, test the cut-out by slowly lowering the operating water level. This can be done by interrupting feed water to the boiler. The burner should stop while water remains visible in the gauge glass. Never let the water drop out of sight! Remember that you are lowering the boiler water level to its minimum safe operating level—use extreme caution in performing this test!

If the fuel cut-out fails to work and the burner continues to operate, reactivate the water source. Contact a heating contractor or boiler repair firm to service the cut-out. It has failed to function and must be repaired as soon as possible!

The burner installed in your boiler is also protected by safety devices designed to prevent the explosion of unconsumed fuel within the boiler. Proper adjustment of the burner and its controls is necessary and will save you money through lower fuel consumption. Improper adjustment can allow soot to build up on heat transfer surfaces. This further reduces efficiency and could cause harmful corrosion which should also be prevented. Adjustment of the burner and testing of its safety controls should be done on a regular basis by qualified burner service personnel.

Observing the burner's operation may prevent future problems. The burner should start smoothly without unusual noises. The flame from the burner should not impinge directly on the boiler. You should not see excessive amounts of soot. Contact your burner service company if you notice any of these conditions.

The condensate return system is important and frequently overlooked. Leakage in the return system wastes money by increasing the need for makeup water and additional water treatment. Depletion of water treatment chemicals may cause scale formation or excessive pitting.

Poor maintenance is the leading cause of boiler accidents.

Examine the condensate return piping for signs of leakage and have it repaired or replaced as necessary. More information about boiler water treatment is available from water treatment companies or your boiler inspector.

There are many sources of reading and study material that will increase your knowledge of boiler operation. The technical sections of public libraries often contain manuals on boiler operation. Check bookstores in your area for boiler information. Local engineering associations are another excellent source of this type of material.

The Helena Vocational-Technical Center offers a home study course on boiler operation. Contact Bill Fife, Helena Vo-Tech, 1115 Roberts, Helena, MT 59601; phone 444-6800.

Perhaps the best source is the boiler inspector who visits your business. The inspector may represent an insurance company or a jurisdiction (state, county, or city). He or she should be a reliable source of information and willing to help. Ask questions until you have a good understanding of your boiler and its controls.

Reprinted with permission from The Locomotive, *Winter 1989, Vol. 66 No. 8. Single subscriptions to* The Locomotive *are available free of charge by writing to The Hartford Steam Boiler Inspection and Insurance Co., One State St., Hartford, CT 06102, Attn: Locomotive.*

Boiler Water Treatment Summary

William E. Bornak, manager of manpower development and recruiting at Betz Industrial in Trevose, Pennsylvania, prepared this summary on boiler water treatment. Bornak spoke at DNRC-sponsored workshops on boiler water treatment in Havre, Great Falls, and Helena in August.

TYPE OF BOILER	PROBLEMS	CHEMICAL GUIDELINES
STEAMING BOILERS	deposition, corrosion	alkalinity: 400+ ppm sulfite: 30-60 phosphate: 40-60 dispersant 40-100+ amines condensate pH 8-9.5 (depends on amine)
HEATING BOILERS 1. low pressure closed systems	corrosion	pH 8-9.5 nitrate/molybdate (see suppliers' guidelines) borate (see suppliers' guidelines) sulfite: 100-150 ppm dispersant 50+ ppm
2. cast iron sectional boilers	deposition-induced cracking	feedwater Total Hardness: 2 ppm max sulfite: 30-50 ppm dispersant 30-50 ppm
3. high temperature hot water (HTHW) systems	corrosion	sulfite: 80-120 ppm dispersant 30+ ppm

Single best investment you could buy: Zeolite Softener (Sears, Culligan, etc.)

Two specific comments are in order regarding amine treatment to raise condensate pH so it will not be corrosive:

1. The amines used in condensate treatment are NOT carcinogenic.
2. Morpholine is not normally used in low pressure systems due to its low volatility, most of it would leave the boiler in the blowdown. It is acceptable in high pressure systems

DNRC Offers Expanded Training On Videocassettes

DNRC's Energy Division has expanded its commercial videotape library to 40 tapes. These videotapes are available for loan free to owners and operators of commercial and institutional buildings.

001 Safe and Efficient Boiler Operations

002 Unit Ventilator Reconditioning

003 Boiler Maintenance, Operation, and Safety

004 Economizer Testing and Tune-up

005 Hot Water Reset For Hydronic Heating System

006 Multizone Hot Deck Controls

007 Guidelines for Steam Trap Troubleshooting

008 Solving the Water Hammer Puzzle

009 Guidelines for Steam System Efficiency

010 Let's Talk Steamtraps/Update

011 The Anatomy of the I.B.

012 Guidelines for Steam Trap Repair

013 Guidelines for Steam/Air Coil System Design

014 Lamps and Luminaires

015 Developing Troubleshooting Skills

016 Basic Air Conditioning, Parts 1 & 2

017 Basic Air Conditioning, Parts 3 & 4

018 Pumps and Motors

019 AC & Variable Speed Drive Controllers

020 Air Conditioning & Refrigeration Systems: Schematics and Symbols

021 Multizone Maintenance & Operations-Lennox

022 Let's Talk PRV's (pressure reduction valves)

023 Introduction to Boilers: An Overview

024 Boiler Design and Construction

025 Boiler Feedwater and Steam

026 Basic Electrical Troubleshooting

027 Boiler Operations, Waterside

028 Boiler Operations, Fireside

029 Honeywell thermostat video tape

030 Johnson Controls thermostat video tape

031 Robertshaw thermostat video tape

032 Fan System Theory and Honeywell Controller tapes

033 Fan System Theory and Johnson Controls Controller tapes

034 Fan System Theory and Robertshaw Controller tapes

035 Oil Burner Repair & Maintenance

036 The Chemistry of Water Conditioning

037 Water Treatment Process Fundamentals

038 Fundamentals of Lighting: Course for Design Engineers and Architects

039 Energy Net

040 O&M's: A Guide to Energy Efficiency

NOTICE

These videotapes are offered as a public service, but some of these tapes are product-oriented. Any reference to specific products or HVAC systems does not constitute an endorsement by the Department of Natural Resources and Conservation. Viewers should thoroughly investigate any claims made and draw their own conclusions about suitability or performance of a product or system before purchase or use.

Ordering Instructions

DNRC will loan its videotapes to you, free of charge, one or two at a time. They must be returned within two weeks. DNRC will pay the cost to ship them to you, but you must pay the return postage. All videotapes are 1/2 inch VHS format.

An order form is provided. Indicate which tape(s) you wish to view and the date you want them. Please use the number that appears directly before the title.

VIDEO ORDER FORM

NAME ______________________ ORGANIZATION ______________________

ADDRESS or P.O. ____

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Return form to: DNRC, Energy Division; 1520 East Sixth Ave.; Helena, MT 59620-2301

PUBLICATIONS ORDER FORM

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Return form to: DNRC, Energy Division; 1520 East Sixth Ave.; Helena, MT 59620-2301

FREE PUBLICATIONS

FROM THE MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

How to Reduce Energy Costs in Your Building

Energy Savings for Restaurants

Energy Savings for Hotels and Motels

Energy Savings for Nursing Homes

Energy Savings for Hospitals

Life Cycle Costing & Local Government Purchasing

Guide to a Successful Project:
Energy Consevation & Management

How to Conserve Energy in Your Domestic Hot Water System

How to Conserve Energy in Your Lighting System

How to Conserve Energy in Your Heating, Ventilating & Air Conditioning Systems

How to Conserve Energy in Your Building Envelope

Grant Helps Hospital Replace Chiller

by Pat Hoban
DNRC Energy Education Specialist

Patients at the Glendive Medical Center were more comfortable this summer thanks in part to a federal energy conservation grant.

"We have a 22-year-old facility that is a combined hospital and nursing home," said administrator John Solheim. "And we had some problems with heating and ventilating. We were looking for ways to solve those problems when we heard about the Institutional Conservation Program."

The federally funded program provides matching funds for energy conservation measures on non-profit schools and hospitals built before 1977. The program is administered in the state by the Montana Department of Natural Resources and Conservation.

> ***"We've saved several thousand dollars in utility bills in just this first full year of operation."***

The first step for the medical center was hiring Energy Conservation Consultants, a Billings engineering firm, to analyze the way the building used energy. The engineers made a series of recommendations, each designed to pay for itself in energy savings in 10 years or less. The analysis, Solheim said, cost $5,000 to $6,000.

The engineers recommended replacing the old steam-fired absorption chiller with a new, more energy-efficient electric model. They estimated the new chiller would pay for itself in energy savings in 7.7 years.

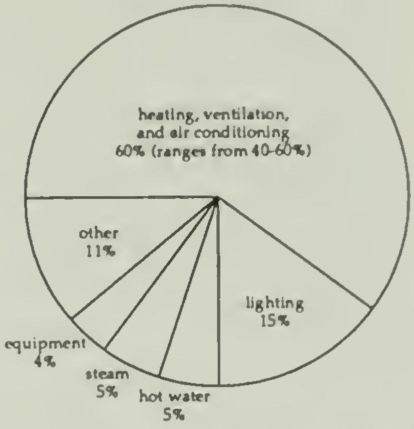
"When we saw the savings potential," Solheim said, "we wanted to get started right away, but capital funds aren't always available. It's hard to get the kind of money we needed from your operating budget."

The medical center received a $22,873 ICP grant to help cover the cost of replacing the chiller. "We were thrilled to get the grant," Solheim said. "We probably wouldn't have been able to go ahead with the project otherwise."

They installed the new chiller in the spring of 1989. "It's reduced our operating costs tremendously," Solheim said. "And it updated our system so we have more cooling in our facility. That means our patients and staff are more comfortable. We used to get lots of complaints from patients, physicians, and staff members about the temperature in the summer, but I didn't get any complaints this year."

HOSPITAL ENERGY USE

National Average



Source: American Hospital Association

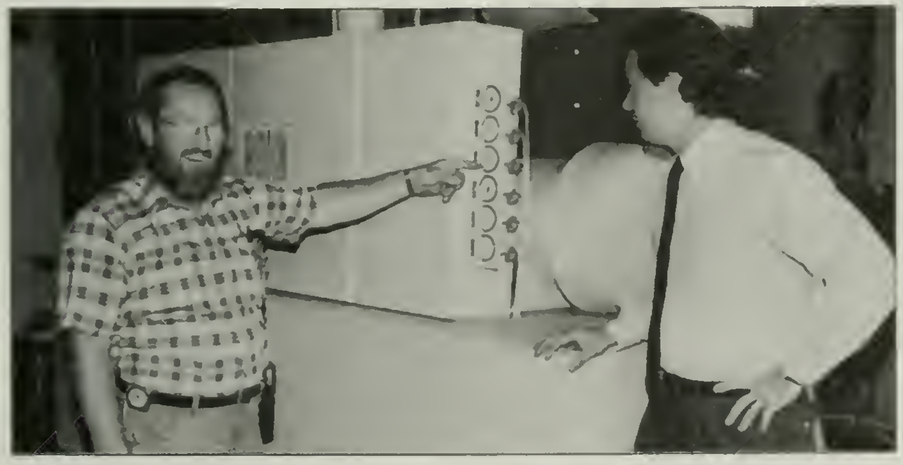
"We've saved several thousand dollars in utility bills in just this first full year of operation," said the center's chief engineer Ted Tinjum.

He added that the new chiller is much less complicated to operate and doesn't require anywhere near as much maintenance and upkeep as the old one did.

"With the old steam-fired chiller," Tinjum said, "we had to keep two boilers going steadily all summer. With the new chiller we keep only one boiler working on a light load for hot water and cool nights, so we have to do much less maintenance on the boilers."

Solheim said the grant did involve some paperwork, both in applying for the grant and in follow-up stages to make sure the center is getting the expected energy savings.

But, he said, "I would recommend the ICP program to any hospital. We'd do it again if we had any other projects."



Ted Tinjum, left, and John Solheim of the Glendive Medical Center—photo by Jon Feller of the Glendive Ranger-Review

Montana Power Offers Funding for Conservation

Montana Power Company will pay for up to 75 percent of the cost of electric energy conservation measures for some of its electric customers around the state.

Under its Electric Conservation Purchase Program, Montana Power will consider retrofit projects involving commercial, governmental, multifamily residential, or industrial facilities. Projects should emphasize winter electric energy and demand savings. Montana Power is especially interested in cost-effective projects involving: energy management systems; heat recovery; load shifting, such as thermal storage or load scheduling; lighting retrofits; demand reduction measures; thermal efficiency improvements; variable speed conversions; and equipment efficiency improvements.

One recently completed project was a $467,000 retrofit at the Radisson Northern Hotel in Billings. Montana Power provided $281,000 for the project, which is expected to cut the Northern's electric bill by $110,000 to $125,000 a year. The retrofit included installing a building automation system that controls the HVAC equipment, air and domestic hot water temperature, air flow, and noncritical lighting. The system provides on-off control, night setback, automatic control of guest room temperature set points, and peak shaving. The retrofit also included converting corridor lighting from incandescent to fluorescent and replacing some air conditioners with heat pumps.

Montana Power also provided $50,000 to help install an energy management system on a 10-story, 71,000-square-foot office building. The system, which cost a total of $80,000, will save the building owners about $15,000 a year on their electricity bills.

And Montana Power provided $24,000 of the $66,000 needed to replace the incandescent lights in one school with fluorescent lights. Another school district is currently switching the HVAC system in its administration building from constant air volume to variable air volume; Montana Power will provide approximately $20,000 of the $67,650 needed for the project.

The deadline for proposals is November 30, 1990. Montana Power reserves the right to reject any proposals submitted. For more information contact David Houser or Joe Schwartzenberger at Montana Power Company, 40 East Broadway, Butte, MT 59701; phone: 723-5421. Schwartzenberger encouraged people to contact him or Houser before doing any extensive proposal preparation.

ICP Funds for Your School or Hospital

This year Montana schools and hospitals will share between $900,000 and $1.5 million under the Institutional Conservation Program. ICP will provide up to 50 percent of the cost of installing energy conservation measures on schools and hospitals built before 1977.

The deadline for applications for ICP funding is December 1, 1990. For more information about the program, contact Connie Onstad at DNRC, phone 444-6697.

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Department of Natural
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Lee Metcalf Building
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Helena, MT 59620-2301

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For Commercial and Institutional Building Operators

July 1991

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HELENA, MONTANA 59620

Energy Accounting Workshop

First step to energy savings

Accounting techniques that can cut energy bills hundreds and even thousands of dollars a year will be the focus of six workshops that are being held throughout Montana this summer.

Sponsored by the Department of Natural Resources and Conservation (DNRC), the half-day workshops are free. They will cover the basics of tracking energy use and using the information to control energy costs. The workshops are geared toward workers at hospitals, schools, and other institutions—especially administrators, clerks, business managers, and accountants.

Workshop topics include: analyzing your utility bills, determining energy-use patterns in your building, setting up an energy accounting spreadsheet for your building costs, and producing energy-use graphs and reports. Each institution will receive a copy of Dataform, a Lotus-based, energy accounting software package designed by DNRC staff members.

DNRC's Connie Onstad will lead the workshops. She encourages participants to calculate the amount of square feet of heated space in their buildings and bring their calculations to the workshop. They should also bring the past year's utility bills and a calculator to the workshop.

"That way," she said, "they can build a personalized energy accounting file for their facility during the workshop."

According to Onstad, energy accounting can:

- Show where and how much energy is being used
- Identify areas with greatest savings potential
- Justify capital expenditure decisions
- Show results of your energy conservation efforts
- Gain management support
- Detect increased energy use, allowing you to act quickly to reduce it
- Identify billing errors

Locations and dates are listed below. Advanced registration isn't necessary for these free workshops. If you have specific questions, call Connie Onstad at DNRC, 444-6697.

Boiler Course Offered

A fundamental course on low-pressure steam boilers and systems will be held July 15-19 at Western Montana College in Dillon. During the last day of the course, participants will take the state boiler operator's license exam. The course costs $125. For details call Western Montana College at 1-800-WMC-MONT.

Inside....

This edition of *Energy Source* features information on:

- Recycling office paper
- Reducing office waste
- Free videotape library
- New laws and tax credits

Thursday, July 25	Bozeman	1:30–5:00 P.M.	Willson Middle School (Room number will be posted) 404 West Main
Wednesday, July 31	Missoula	1:30–5:00 P.M.	Missoula County High School Admistration Building - Board Room 915 South Avenue West
Tuesday, Aug. 13	Kalispell	1:30–5:00 P.M.	Flathead Electric Co-op 2510 Highway 2 East
Thursday, Aug. 15	Havre	1:30–5:00 P.M.	Robins School Administration Building - Board Room 425 6th St.
Tuesday, Aug. 20	Glendive	1:30–5:00 P.M.	Dawson County High School - Room 128 900 North Merrill
Tuesday, Aug. 27	Hamilton	1:30–5:00 P.M.	Council Chambers 223 South 2nd

Why Should Your Office Recycle?

The average office worker throws away at least a half-pound of high-grade, recyclable paper each day, according to Keep Montana Clean and Beautiful, a non-profit organization that promotes recycling.

Assuming each employee works 240 days a year, each worker discards up to 120 pounds of recyclable paper a year; and 17 workers would toss out a ton of paper each year. One study showed that in 1988, 43.7 million tons of paper and paperboard were disposed of in municipal solid waste systems. Up to 77 percent of the solid waste produced in a commercial building can be recycled; most of it is computer printouts, stationery, and bond and photocopy paper.

Keeping that paper out of the local landfill can pay off, both for your organization and for your community.

1. RECYCLING SAVES ENERGY AND NATURAL RESOURCES.

Each ton of recycled paper saves 7,000 gallons of water, 2.5 barrels of oil, and 17 trees.

2. RECYCLING PROTECTS THE ENVIRONMENT.

Each ton of recycled paper saves 3.3 cubic yards of space at the local landfill. Another benefit of recycling paper is a reduction in air and water pollution. According to the Worldwatch Institute, paper made from recycled pulp creates 74 percent less air pollution and 35 percent less water pollution than paper made directly from trees.

3. RECYCLING SHOWS THAT YOUR FIRM IS RESPONSIBLE.

By recycling paper and buying recycled paper, your organization shows that it cares about the environment. Recycling can enhance your organization's image with the fast-growing public that supports conservation in this country.

4. RECYCLING DIRECTLY BENEFITS YOUR OFFICE.

Since paper makes up as much as 80 percent of the trash in commercial buildings, recycling paper could significantly cut your waste disposal costs. Your recycling program could also generate revenue, since recycling firms usually pay for computer printouts and white office paper. These profits can be used to support favorite charities, employee programs, doughnuts for employees, office parties, and other activities.

5. RECYCLING IS EASY AND MAKES EVERYONE FEEL GOOD.

Many people who serve as recycling coordinators in Helena's state agencies report that employees are eager to participate in recycling programs because they believe that recycling is the right thing to do. "A lot of our people are parents," one coordinator said, "and they like to show their children that they're recycling."

RECYCLE

EACH TON OF RECYCLED PAPER SAVES . . .

17 Trees ...
7,000 Gallons of Water ...
2.5 Barrels of Oil ...
3 Cubic Yards of Landfill Space ...

MOTHER EARTH THANKS YOU

New Law Requires State to Cut Solid Waste by 25 Percent

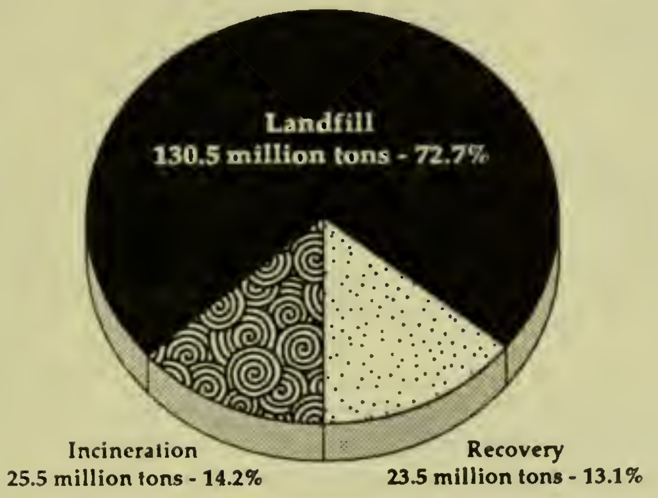
A new state law calls for cutting the state's solid waste by at least 25 percent over the next five years.

The 1991 Montana Legislature passed the Integrated Waste Management Act (HB 160) that requires state agencies and the university system to recycle and practice source reduction (waste prevention) by July 1, 1992. The new law encourages composting yard wastes and recycling office and computer paper, cardboard, and used motor oil. It also encourages that computer technology such as electronic bulletin boards and mail be used to save paper.

Under the act, state agencies will purchase recycled paper, glass, automobile and truck tires, motor oil, and lubricants if "technologically practical and reasonably cost effective." By Jan. 1, 1996, "95 percent of the paper and paper products used by state agencies, universities and the legislature must be made from recycled material that maximizes post-consumer material content," the law states.

Under another provision of the act, the Department of Health and Environmental Sciences (DHES) will develop a comprehensive solid waste management program for the entire state. Local officials, citizens, environmental organizations, and the solid waste and recycling industries will all be involved in the planning process. Both financial and technical assistance will be available for local governments to begin solid waste management programs. For more information, contact the Solid and Hazardous Waste Bureau, DHES, 836 Front St., Helena, MT 59620; phone 444-1430.

MUNICIPAL SOLID WASTE IN THE U.S.



Total weight – 179.6 million tons

Source: EPA, 1988

How to Start a Recycling Program at Your Office

FREE GUIDES

Order free copies of "A Guide to Office Paper Recycling" and "The Montana Recycling Directory" from Keep Montana Clean and Beautiful, P.O. Box 5925, Helena, MT 59604; phone: 443-6242. Other good sources of recycling information are the Solid and Hazardous Waste Bureau, Department of Health and Environmental Sciences, 826 Front St., Helena, MT 59620; phone: 444-1430; and the National Appropriate Technology Assistance Service, P.O. Box 2525, Butte, MT 59702-2525; phone: 1-800-428-1718. Rodale Press, 33 E. Minor St., Emmaus, PA 18098, offers *Keeping Your Company Green*, a free, 92-page book with ideas on waste prevention, recycling, and packaging alternatives.

WHAT TYPES OF PAPER ARE RECYCLABLE?

Contact your local recycling center to find out the types of paper it is currently buying and the services it offers. Some centers will pick up your paper and provide collection bins to you on a lease or loan basis.

The market for recycled paper in Montana is still rather volatile, but recyclers are most interested in computer printout paper. Although they are interested in white office paper, recyclers aren't particularly interested in colored paper or newspapers at this time. Some recyclers, however, will accept these on a donation basis or will pay you a small fee.

State Employees Lead the Way in Paper Recycling

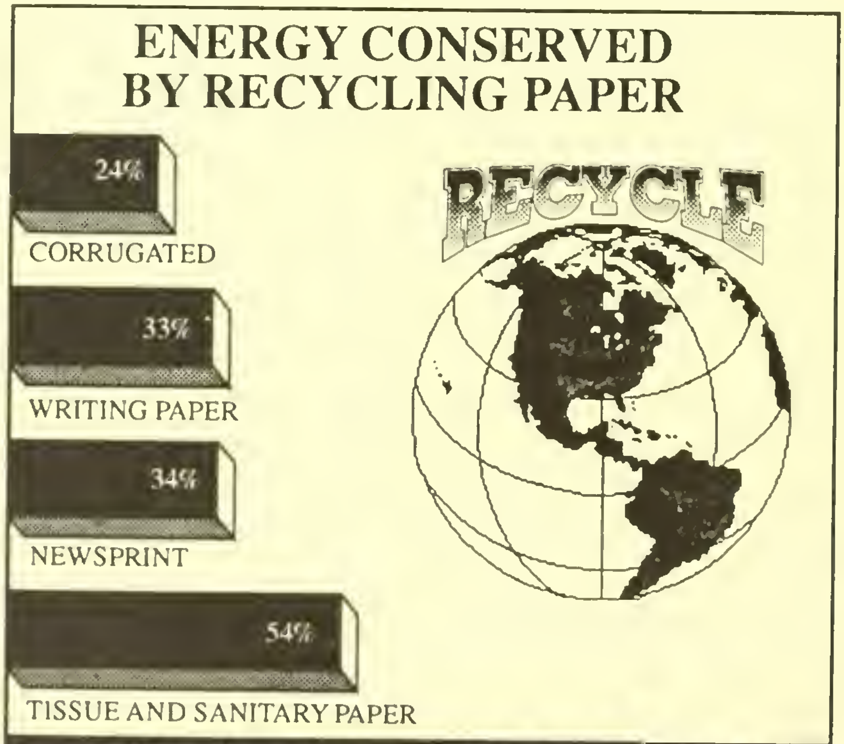
State employees in Helena recycled 15.5 tons of paper during May, bringing the total amount of paper recycled by state offices during the past 11 months to 81.5 tons.

All 35 state agencies with offices in Helena are now recycling office paper. Thirty-four agencies participate in Recycle Montana, coordinated by the Department of Natural Resources and Conservation, and one agency operates its own recycling program.

Initiated by Governor Stan Stephens, Recycle Montana involves cooperation among government agencies, volunteer groups, and the private sector. Besides state employees, participants include:

- Keep Montana Clean and Beautiful, a non-profit organization that helps organize and promote Recycle Montana
- Montana Recycling, a private firm that buys waste paper from state agencies
- County Market of Helena, which donated recycling boxes for state employees' offices
- The U.S. Department of Energy, which provided funds for the one-year pilot program

Governor Stephens began the program to test the feasibility of recycling in state agencies and provide an example for the rest of the state.



Each ton of recycled paper diverts three cubic yards of waste paper from the local landfill.

> *"Support for recycling in the Capitol was impressive, both in terms of the amount of paper the legislators recycled and in terms of the new recycling legislation they passed."*

Among the participants in Recycle Montana were the 1991 Montana legislators and others associated with the session. Twenty-seven tons of paper were collected from recycling boxes in legislative offices, meeting rooms, and House and Senate chambers during the four-month session.

"Program instructions and general recycling information were offered to legislators in the same way as to all employees," explained DNRC's Peggy Nelson. "Support for recycling in the Capitol was impressive, both in terms of the amount of paper the legislators recycled and in terms of the new recycling legislation they passed."

Recycle Montana has received an enthusiastic response throughout state government, Nelson said, adding that more than 4,000 people work for the state agencies participating in the program.

"Volunteer recycling coordinators in each building planned the program for their facilities with assistance from DNRC," she explained. Most of the agencies put recycling boxes next to photocopiers and computer printers; some agencies also place them next to each employee's desk.

DNRC Offers Videocassettes for Building Operators

DNRC's Energy Division has 44 commercial videotapes in its library. These videotapes are available for loan free, one or two at a time, to owners and operators of commercial and institutional buildings in Montana. See the reverse side of this insert for more tape listings and ordering instructions. All tapes are in 1/2-inch VHS format.

NEW VIDEOS

041 **Office Lighting Design,** 1986, EPRI, 9 min. Shows variety of lamps available and how they can be used to save electricity and improve productivity.

042 **External Boiler Inspection,** NUS, 10 min. Shows how to find casing support failure, inspect valves, and check for leaks, corrosion, and other problems before they become dangerous.

043 **Boiler Waterwall Inspection,** NUS, 13 min. Covers problems such as overheating, tube support failure, corrosion, ash accumulation, and refractory failure.

044 **Bringing Solar Electricity to Earth,** 1990, EPRI, 29 min. Discusses worldwide research efforts on solar cells or photovoltaics and shows how they're being used today.

001 **Safe and Efficient Boiler Operations,** 1987, OSU, 36 min., with handbook. Shows how to save money on fuel, repairs, and other operating costs for small boilers.

002 **Unit Ventilator Reconditioning,** ETH, 22 min. Looks at O&M of ventilators, and face and by-pass dampers. Covers cleaning, re-gasketing, and adjusting linkages.

003 **Boiler Maintenance, Operation, and Safety,** ETH, 30 min., with handbook. Covers operating characteristics and safety controls for atmospheric and power burner boilers.

004 **Economizer Testing and Tune-up,** ETH, 30 min. Shows methods for adjusting make-up and return air dampers in a HVAC system.

005 **Hot Water Reset For Hydronic Heating System,** ETH, 17 min., with handbook. Describes hot-water system, reset control, three-way mixing valve, and checking set points.

006 **Multizone Hot Deck Controls,** ETH, 17 min., with handbook. Describes multizone air handling system and resetting of deck temperature based on outside temperature.

007 **Guidelines for Steam Trap Troubleshooting,** AMW, 19 min. Outlines how to establish a preventive maintenance program, emphasizing testing of various traps.

008 **Solving the Water Hammer Puzzle,** AMW, 24 min. Discusses causes, effects, and prevention of water hammer on a steam system.

009 **Guidelines for Steam System Efficiency,** AMW, 15 min. Looks at piping needed to achieve optimum efficiency.

010 **Let's Talk Steamtraps/Update,** 1984, AMW, 32 min. Discusses operation of steam traps, inverted bucket, thermostatic, disc, and differential condensate controllers.

011 **The Anatomy of the I.B.,** AMW, 15 min. Looks at performance and components of inverted bucket steam traps.

012 **Guidelines for Steam Trap Repair,** AMW, 1988, 20 min. Outlines types of steam traps, gives techniques for repairing each, and shows how to spot faulty ones.

013 **Guidelines for Steam/Air Coil System Design,** AMW, 1988, 13 min. Explains causes of frozen steam coils and how to prevent problems.

014 **Lamps and Luminaires,** 1982, IES, 20 min. Talks about energy saving lamps, high intensity discharge, and warm and cool renditions.

015 **Developing Troubleshooting Skills,** TPC, 1982, 115 min., seven parts. Looks at strategies using specific tools, records, and diagrams for approaching mechanical and electrical problems, and conducting planned and breakdown maintenance.

016 **Basic Air Conditioning, Parts 1 & 2,** 1979, TPC, 29 min., with booklet. "Measurement of Heat" and "Pressure & Heat Transfer" discuss basics of BTUs, conduction, convection, radiation, and Boyles and Charles laws.

017 **Basic Air Conditioning, Parts 3 & 4,** 1979, TPC, 32 min., with booklet. "The Air Conditioning Cycle" and "Operation of an Air Conditioner" discuss vaporizers, compressors, condensers, coils, fins, gauges, and valves.

018 **Pumps and Motors,** 1987, TPC, 20 min. Offers a basic understanding of how hydraulic pumps and hydraulic motors work. Shows how to decipher model codes and what they mean.

019 **AC & Variable Speed Drive Controllers,** 1987, TPC, 20 min. Gives information about electric motors, AC current, inverters, converters, induction, synchronous speed, slip, and hertz.

020 **Air Conditioning & Refrigeration Systems: Schematics and Symbols,** 1982, TPC, 15 min., with booklet. Shows basics of reading diagrams for compressors, condensers, and evaporators and for discharge and auxiliary lines.

021 **Multizone Maintenance & Operations-Lennox,** ETH, 18 min. Looks at tune-up and adjustment of a roof-top HVAC system.

022 **Let's Talk PRV's** (pressure reduction valves), 1987, AMW, 30 min. Discusses saturation curves, automatic and mechanical controllers, diaphragms, bellophragms, bellows, and pistons.

023 **Introduction to Boilers: An Overview**, 1988, ISA, 34 min. Offers summary of coal, oil, and gas-fired boilers and steam systems. Describes what boilers do and how they operate.

024 **Boiler Design and Construction**, 1988, ISA, 26 min. Talks about fire-tube and water-tube boilers.

025 **Boiler Feedwater and Steam**, 1988, ISA, 27 min. Looks at feedwater controls, boiler tubes, water chemistry, blowdown techniques, and safety devices.

026 **Basic Electrical Troubleshooting**, 1981, ITI, 17 min. Uses test instruments to locate circuit defects, such as opens, shorts, and excessive resistance and current.

027 **Boiler Operations, Waterside**, 1974, VCA, 20 min. Talks about boiler cut in/off, blow down, header pressure, steam controls, and valves.

028 **Boiler Operations, Fireside**, 1974, VCA, 15 min. Looks at feed systems and combustion in gas/oil-fired systems, drafts, ignition, and metering ratios.

029 **Honeywell thermostat video tape**, 1989, ECI, 35 min. Covers pneumatic thermostats and cleaning and calibration of nine types.

030 **Johnson Controls thermostat video tape**, 1989, ECI, 36 min. Covers pneumatic thermostats and cleaning and calibration of nine types.

031 **Robertshaw thermostat video tape**, 1989, ECI, 32 min. Covers pneumatic thermostats and cleaning and calibration of seven types.

032 **Fan System Theory and Honeywell Controller tapes**, ECI, 65 min. Describes mixed air systems, heat pumps, furnaces, duct systems, and calibration and repair of 25 Honeywell components.

033 **Fan System Theory and Johnson Controls Controller tapes**, ECI, 63 min. Describes mixed air systems, heat pumps, furnaces, duct systems, and calibration and repair of 23 Johnson components.

034 **Fan System Theory and Robertshaw Controller tapes**, ECI, 57 minutes. Describes mixed air systems, heat pumps, furnaces, duct systems, and calibration and repair of 21 Robertshaw components.

035 **Oil Burner Repair & Maintenance**, Navy, 37 min. Is public domain and may be copied. Discusses how to clean and adjust an oil-fired boiler.

036 **The Chemistry of Water Conditioning**, 1989, CIC, 60 min., with booklet. Talks about the chemical and molecular structure of water, and contaminants and their effects.

037 **Water Treatment Process Fundamentals**, 1989, CIC, 65 min., with booklet. Addresses oxidation, filtration, adsorption, regeneration, deionization, osmosis, and pH.

038 **Fundamentals of Lighting: Course for Design Engineers and Architects**, IES,1987, 16 hours. A taped event, is home video quality. Topics are nature of light, light sources and energy issues, interior lighting, and exterior lighting.

039 **Energy Net**, Minn, 18 min. This take-off of "Dragnet" follows an energy analysis of a business. Is a good introduction to the dollar benefits of energy conservation.

040 **O&M's: A Guide to Energy Efficiency**, 1984, Utah, 15 min. Is an overview of many of the operation and maintenance items that can be applied to commercial/retail buildings.

Distributors of the Videotapes

AMW - Armstrong Machine Workshop
CIC - Culligan International Co.
ECI - Energy Controls, Inc.
EPRI - Electric Power Research Institute
ETH - E.T. Harlow Co.
IES - Illuminating Engineering Society
ITI - Industrial Training, Inc.
Minn - Minnesota Department of Public Service
Navy - U.S. Navy
NUS - NUS Training Corporation
OSU - Oregon State University
TPC - TPC Training Systems
Utah - Utah Energy Office
VCA - Video Communication Associates

NOTICE

These videotapes are offered as a public service, but some of these tapes are product-oriented. Any reference to specific products or HVAC systems does not constitute an endorsement by the Department of Natural Resources and Conservation. Viewers should thoroughly investigate any claims made and draw their own conclusions about suitability or performance of a product or system before purchase or use.

VIDEO ORDER FORM

NAME ______________________ ORGANIZATION ______________________

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PLEASE SEND THE FOLLOWING VIDEOTAPE(S):

1. ______________________ 2. ______________________

Preferred date of receipt ______________

Return form to: DNRC, Energy Division; 1520 East Sixth Ave.; Helena, MT 59620-2301

Twenty-three Ways to Prevent Waste Paper at Work

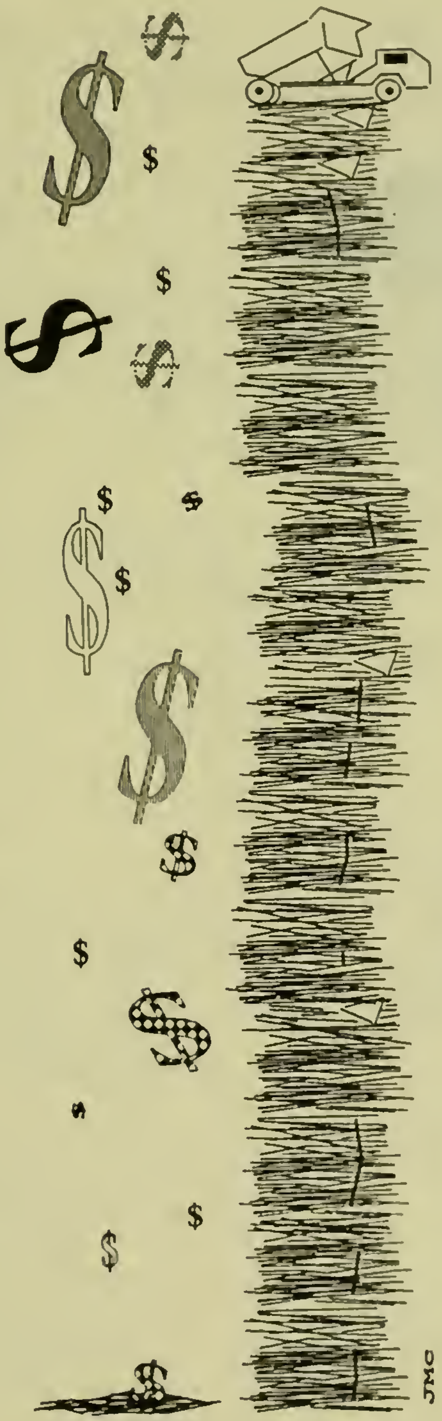
Municipal solid waste management will be the top priority of both government and private industry during the 1990s. As available space in landfills dwindles, state and local governments are trying to find ways to reduce the amount of trash reaching those landfills. Strict regulations proposed by the U.S. Environmental Protection Agency also will affect landfill space.

The United States produced nearly 180 million tons of municipal solid waste in 1988, according to EPA figures. Without reducing this waste, EPA estimates that the amount of solid waste produced by Americans in 1995 could reach 200 million tons.

In addition to encouraging recycling, EPA encourages Americans to practice waste prevention as a pre-cycling step, especially in the work place.

FOR WRITING OR PRINTING PAPER:

1. Photocopy documents on both sides of the paper. Most copiers feature duplex copying options.
2. Buy recycled paper.
3. Buy paper that can be recycled most easily—white pads instead of yellow and bond paper instead of groundwood computer paper.
4. Keep mailing lists current.
5. Reuse manila envelopes, file folders, boxes, and shipping materials such as polystyrene peanuts and bubble wrap.
6. Make scratch pads from used paper, or send your used paper to day care centers or home schools.
7. Circulate memos, documents, periodicals, and reports rather than photocopying or buying individual copies for all office personnel.
8. Post memos or announcements on bulletin boards.
9. Send electronic messages on your computer network instead of making paper copies.



10. Use outdated letterhead for in-house memos.
11. Proofread documents on the computer screen before printing.
12. Save documents on floppy disks instead of making hard copies.
13. Reduce the amount of junk mail you receive by writing to the Mail Preference Service, Direct Marketing Association, P.O. Box 3861, New York, NY 10163-2861.
14. Use a centralized filing system.

FOR EQUIPMENT:

15. Use remanufactured office equipment.
16. Invest in office equipment with waste reduction features, such as high-quality, durable, repairable equipment, and photocopiers that make two-sided copies.
17. Begin an aggressive preventive maintenance program to keep your office equipment in top working order.
18. Buy rechargeable batteries.
19. Recharge fax and laser printer cartridges.
20. Install reusable furnace and air conditioner filters.

FOR FOOD AND PERSONAL SERVICE:

21. Use cloth roll towels in restrooms instead of paper towels.
22. Use reusable mugs instead of disposable ones for beverages.

FOR MOTIVATION:

23. Offer awards or recognition for employee waste-reduction suggestions and achievements.

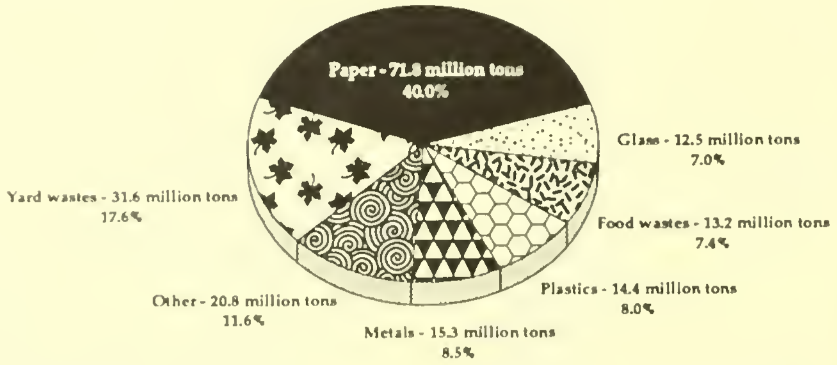
Businesses Receive Tax Credits for Recycling

The 1991 Montana Legislature approved tax credits for businesses that use recycled materials. Under this new law (SB 110), businesses may take an additional five-percent deduction for using recycled material for products that are otherwise deductible as a business-related expense.

Another provision of the new law gives individuals, corporations, partnerships, or small business corporations a 25-percent tax credit on "property purchased to collect or process reclaimable material or to manufacture a product from reclaimed material." The credit can be applied toward property purchased between Jan. 1, 1990, and Jan. 1, 1996, but not toward property used to produce energy from reclaimed material.

For details check with the Department of Revenue, Mitchell Building, Helena, MT 59620; phone: 444-2837 for individual income tax information, or 444-2441 for corporate tax information.

MATERIALS IN MUNICIPAL SOLID WASTE
BY WEIGHT



Total weight - 179.6 million tons

Source: EPA, 1988

The Montana Department of Natural Resources and Conservation publishes *Energy Source* several times a year with funding from the U.S. Department of Energy.

Address your comments and suggestions to Pat Hoban, DNRC, 1520 East Sixth Avenue, Helena, MT 59620-2301; phone: 444-6697.

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Energy Source

For Commercial and Institutional Building Operators

January 1993

***ATTENTION:** To prevent deletion from the mailing list, you must return the mail-back form. Please make corrections and changes on the return mailing label.*

This issue of *Energy Source* is the beginning of a series of informational bulletins called the *Building Operator* and is being distributed to a combined mailing list compiled by the Montana Local Government Energy Office and the Department of Natural Resources and Conservation. State government agencies are committed to providing quality information to building operators and local government officials, while at the same time streamlining production and mailing costs.

The *Building Operator* will be provided four times a year. Technical information will cover a wide variety of energy-efficient technologies and modifications for commercial buildings. Additional information concerning topics of particular interest to commercial building operators in Montana will be provided periodically along with information concerning training programs and services provided by DNRC, MLGEO, BPA, and utilities.

Teleconference Scheduled

A two hour teleconference titled *Geothermal Heating and Cooling '93* is scheduled for March 3, 1993. DNRC will sponsor a site in Helena and would be happy to help anyone interested in setting up a site in their town. For more information, contact Tristen Shinnick of DNRC at 444-6751.

New Videos Available

The DNRC video library has added nine new titles this past year. Be sure to take a look at the enclosed pamphlet on the video library.

Local Government Participation Sought in Electric Conservation Program

The Montana Local Government Energy Office continues to work with local government facilities to identify and reduce energy inefficiency. The MLGEO in partnership with MPC, in continuation of the Electric Conservation Program, is looking for local government facility participation. This pilot project is unique in that it was designed to specifically target county and municipal structures. Participants will receive walk through energy audits followed by MPC review to determine if detailed engineering analysis is warranted. The expense of this analysis, to verify cost effectiveness of electrical improvements, will be funded by MPC. Projects with good potential to recover electrical resources through improved efficiency will be cost shared with the participating jurisdiction.

The future of continued utility and local government partnerships will largely depend on the willingness of local jurisdictions to participate. Please give Dick Torkildson a call in Helena at the MLGEO office, 442-5209.

MLGEO

- ➤ ENERGY ASSISTANCE FOR LOCAL GOVERNMENTS
  - ➤ Technical
  - ➤ Financial
  - ➤ Informational

MONTANA LOCAL GOVERNMENT
ENERGY OFFICE

Dick Torkildson
MLGEO
2711 Airport Road
Helena, MT 59601
442-5209

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ATTENTION: *To prevent deletion from the mailing list, this portion of the newsletter must be returned. Please make corrections on the return mailing label provided on the reverse side.*

DNRC is putting together a plan to provide building operator training. We would like input on which of the following items would be relevant to you. Please check as many as you like and provide additional topics under "other."

HEATING

- ☐ boiler water treatment
- ☐ boiler control systems
- ☐ boiler operation and maintenance
- ☐ boiler theory
- ☐ steam traps
- ☐ night setback thermostats
- ☐ heat exchanger
- ☐ ground source heat pumps
- ☐ Variable Air Volume
- ☐ HVAC
- ☐ other (specify) ____________________

COOLING

- ☐ economy cooling measures
- ☐ large swamp coolers
- ☐ refrigeration systems and new refrigerants (non CFC)
- ☐ other (specify) ____________________

BUILDING ENVELOPE

- ☐ insulation
- ☐ window block up
- ☐ indoor air quality
- ☐ asbestos
- ☐ other (specify) ____________________

LIGHTING

- ☐ new lighting technologies
- ☐ occupancy sensors
- ☐ electronic ballasts
- ☐ other (specify) ____________________

OTHER

- ☐ variable speed motor drives and electronic motor starters
- ☐ high efficiency electric motors
- ☐ motor operation and maintenance
- ☐ swimming pool covers
- ☐ energy accounting–"What fuel bills tell you"
- ☐ other (specify) ____________________

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Energy Source

DOCUMENTS COLLECTION
1993

For Commercial and Institutional Building Operators

May 1993

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Local Governments Participate in MPC–MLGEO Program

The Montana Local Government Energy office (MLGEO) is pleased to announce the participation of 23 county and municipal jurisdictions in the pilot Electric Conservation Program sponsored by the Montana Power Company (MPC) and MLGEO. Participants have been provided with a report discussing the results of a preliminary energy audit of their facilities.

MLGEO

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MONTANA LOCAL GOVERNMENT ENERGY OFFICE

Dick Torkildson
MLGEO
2711 Airport Road
Helena, MT 59601
442-5209

The audit report identifies energy system components, energy consumption, and cost for each use and fuel type. Written recommendations are given for low-cost, no-cost operation and maintenance (O&M) improvements that will result in increased energy efficiency. Energy conservation activities that are more expensive than O&M improvements are also identified.

There are many opportunities to improve the energy efficiency of local government facilities, while reducing overall costs. Such opportunities often involve lighting, heating and cooling systems, and air handling measures, as well as improvements to the building envelope. MPC's current rebates for efficient lighting and motor installations make such energy improvements even more cost effective. Interested persons may contact MLGEO for more details about the Electric Conservation Program.

Electric Ideas Clearinghouse

The Electric Ideas Clearinghouse (Clearinghouse) is a source of fast, free energy information for residents of Montana, Oregon, Idaho, and Washington. Access to the Clearinghouse is available through a toll-free telephone hotline and computer bulletin board.

Information available includes advice from technical experts, product information, and reports on practical energy experience. Some of the topics covered include: HVAC, motors, pumps, insulation, boilers, lighting, refrigeration, renewable resources, computer simulations and electric systems. Information about energy workshops and conferences is also available.

The Clearinghouse is sponsored by Bonneville Power Administration and several utilities. Montanans can reach the Clearinghouse in three ways, all free:

Hotline—1-800-872-3568
(M–F 8 AM–5 PM Pacific time)

Fax—1-800-872-3882

Electronic Bulletin Board—
1-800-762-3319 (24 hours a day)

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- ☐ Variable Air Volume
- ☐ HVAC
- ☐ other (specify) ______________

COOLING

- ☐ economy cooling measures
- ☐ large swamp coolers
- ☐ refrigeration systems and new refrigera
- ☐ other (specify) ______________

Energy Source

For Commercial and Institutional Building Operators

May 1993

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Financing of Energy Projects Undergoing Changes

The state legislature has directed the Energy Division of the Montana Department of Natural Resources and Conservation (DNRC) Energy Division to create a self-sustaining program to fund energy retrofits in schools and hospitals. DNRC is working on the design of the program, which will provide flexibility in project selection.

Under the program, energy improvements in participating facilities will be financed through loans. The savings realized by participants through avoided energy costs will exceed payments on the loans. As in the past, DNRC will fund technical studies and assist in project development and implementation.

The program will replace the existing Institutional Conservation Program (ICP). Because of a decrease in federal funds allocated to ICP, the money for grants under that program has declined. Also, new federal regulations offer increased opportunities for leveraging ICP money with other funding sources.

This fall, DNRC will revise Montana's state plan for ICP and make it available for public review. The revisions will reflect the altered scope of ICP. DNRC will provide more information soon.

Free Computer Spreadsheet Available

DNRC has developed a computer software program on a Lotus 123 spreadsheet, called DATAFORM, that can be used to analyze the energy consumption of a building. DATAFORM enables building managers to set up an energy-accounting system for recording energy cost and use. The measurements of heated areas in a building are also recorded, and the building's energy use is calculated on a "per square foot" basis. DATAFORM provides a comparison of annual energy consumption with a baseline year, which allows for the monitoring of energy conservation measures in a building.

Energy data are collected from monthly utility bills and entered into DATAFORM. Factors such as cost and amount of fuel and electricity are tracked to understand how a building uses energy. Fuel types that can be charted include electricity, natural gas, propane, fuel oil, butane, and coal. The information analyzed can be printed out as reports and graphs.

Persons wishing to receive a free copy of DATAFORM should send a request—accompanied by a 3.5 inch, double-density floppy disk—to Ronald Kainu, Department of Natural Resources and Conservation, 1520 E. 6th, Helena, MT 59620-2301.

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